PUBLIC HEALTH REPORTS

Volume 73, Number 5

MAY 1958

Published since 1878

CONTENTS

	Page
Ejection and automobile fatalities *Boris Tourin*	381
World Health Organization, 1948–1958	392
Ten years of WHO progress *M. G. Candau*	392
WHO contributions to child health *Jessie M. Bierman and Martha M. Eliot*	402
Nursing around the world *Virginia Arnold*	412
Afghanistan charts health goals *Glenn S. Usher*	418
International population movements as aids to communicable disease control *Clarence A. Smith, Johannes Stuart, and William C. Watson, Jr.*	423
Radioactive particles in the atmosphere at Cincinnati, Ohio *R. Louis Bradshaw and Lloyd R. Setter*	431
Diphtheria in the United States in 1956 *Helen A. Moore*	439
The imported fire ant *F. G. Favorite*	445

Continued ▶

frontispiece

In Mexico's war against malaria, school children learn the aims of the eradication campaign.

CONTENTS *continued*

	Page
Federal and State poultry programs. *Joe W. Atkinson*	449
Diphtheria immunity status in Montgomery County school seniors and adults. *John B. Atwater and William J. Peeples*	456
Comparison of CF and HI tests on psittacosis-LGV serums. *Matthew A. Bucca*	461
Variation in three staphylococcal typing phages. *John E. Blair and E. T. Bynoe*	465
Poverty, pica, and poisoning. *J. Edmund Bradley and Samuel P. Bessman*	467
Rat, flea, and murine typhus recurrence following eradication measures. *William W. Smith*	469
Short reports and announcements:	
Advisory Committee on Radiation	391
Manila meeting on social, preventive medicine teaching	401
Perinatal mortality conference	417
NIH Board of Scientific Counselors	429
International mail pouch	430
Regional medical directors reassigned	438
Institutes on nuclear energy	444
Environmental engineering curriculum	448
Home safety activities	455
London seminar in health education	460
Local health departments and rehabilitation	464
PHS exhibit	466
Legal criteria for evidence of intoxication	468
Studies on radiation hazards scheduled	473
Publications	474

PUBLIC HEALTH REPORTS

BOARD OF EDITORS

EDWARD G. McGAVRAN, M.D., M.P.H.
Chairman

MARGARET G. ARNSTEIN, R.N., M.P.H.
HAROLD D. CHOPE, M.D., DR.P.H.
MANDEL E. COHEN, M.D.
CARL C. DAUER, M.D.
H. TRENDLEY DEAN, D.D.S.
J. STEWART HUNTER, M.A.
CHARLES V. KIDD, PH.D.
ALEXANDER D. LANGMUIR, M.D., M.P.H.
VERNON G. MacKENZIE
LEO W. SIMMONS, PH.D.
WILSON T. SOWDER, M.D., M.P.H.
MARY SWITZER
FRANKLIN H. TOP, M.D., M.P.H.

Managing Director
G. ST.J. PERROTT

Chief, Division of Public Health Methods

Executive Editor: Marcus Rosenblum
Managing Editor: Winona Carson
Asst. Managing Editor: Martha Seaman

Public Health Reports, published since 1878 under authority of an act of Congress of April 29 of that year, is issued monthly by the Public Health Service pursuant to the following authority of law: United States Code, title 42, sections 241, 245, 247; title 44, section 220. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, August 24, 1957.

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
MARION B. FOLSOM, *Secretary*

PUBLIC HEALTH SERVICE
LEROY E. BURNEY, *Surgeon General*

EJECTION and AUTOMOBILE FATALITIES

BORIS TOURIN, B.A.

PRIOR to the advent of studies of injuries sustained in automobile crashes, the belief was prevalent that being "thrown clear" of the car during an accident would generally save one's life. As the Automotive Crash Injury Research project of Cornell University Medical College accumulated case histories from the reports of trained police and highway patrol investigators, however, it became clear that this supposition was contrary to the evidence.

The present study uses data from these reports to answer two initial questions: Is the risk of fatal injury greater for those ejected from automobiles in an accident than for those who remain inside? What fatality would be expected for those ejected had they remained inside the cars?

Answers to these questions are applied to data on national fatality figures in order to answer a third question, which is the principal objective of this study: If ejection increases the risk of fatality, what is the estimated number of lives that could be saved annually by preventing ejection in injury-producing accidents?

The present study is an extension of an earlier one in which it was observed that ejection from an automobile under crash impact conditions was associated with a double risk of moderate through fatal injuries (*1*). Both the previous and present studies represent portions of the large-scale investigation of injuries in automobile crashes conducted at Cornell University Medical College. The general plan and organization of this investigation have been described in previous reports (*1–4*).

Materials

Detailed accident-injury reports, containing comprehensive information on 3,261 passenger automobiles and their 7,337 occupants, were collected and analyzed and subsequently coded and transferred to punchcards.

All of these accidents had resulted in injury of some kind to at least one of the occupants involved. The accidents ranged in severity from minor to extreme, and the injuries ranged in degree from trivial to fatal.

All common makes and models of American automobiles manufactured prior to 1956 and operated during the sampling period (beginning of 1953 through May 1956) were repre-

Mr. Tourin is chief of the technical section of Automotive Crash Injury Research, a division of the department of public health and preventive medicine, Cornell University Medical College, New York City. *This investigation was supported in part by the Commission on Accidental Trauma of the Armed Forces Epidemiological Board (with funds provided by the Surgeon General, Department of the Army), the National Institutes of Health, Public Health Service, the Ford Motor Co., and the Chrysler Corp.*

sented. Those manufactured after 1956 were excluded because many manufacturers improved their door locks in that year. Doors equipped with these new lock mechanisms have been demonstrated to open less frequently under crash impact conditions and to be associated with a decrease in the frequency of ejection (*2*).

The data were collected at the accident scene in 14 States and 1 city: Arizona, California, Colorado, Connecticut, Indiana, Maryland, Michigan, Minnesota, New York, North Carolina, Pennsylvania, Texas, Vermont, Virginia, and Minneapolis. The States provide the sample with rural accidents; the city, with urban accidents.

In each participating area, police or highway patrolmen in preselected geographic districts completed special report forms and submitted detailed photographs for each injury-producing accident. Examining physicians supplied precise medical information on each injured person. History, data sources, and general methods of the Automotive Crash Injury Research project have been previously outlined (*3*, *4*).

These accidents are believed to be representative of typical crashes in which persons were injured (*3*).

Another source of material was the national motor vehicle fatality figures gathered by the National Office of Vital Statistics and reproduced by the statistics division of the National Safety Council (*5*). Such data are published annually in Accident Facts, where tabulations of accidental deaths and injuries from many sources are collected and classified under gross cause headings.

Definitions

Accident severity: Total decelerative forces and overall structural damage produced by the accident, described in five grades: (1) minor; (2) moderate; (3) moderately severe; (4) severe; and (5) extremely severe and extreme. These terms do not describe the injury effects of the accident, but only the forces and structural damage conditions.

Complete ejection: Complete ejection through a door that has "popped open" as a result of impact against some portion of the car other than the door in question. Occupants defined as completely ejected must be outside the car before sustaining their principal injuries. Doors opened by direct impact to the doors themselves are not classified as open in studies concerned with ejection since occupants adjacent to these doors are quite likely to have been seriously injured prior to leaving the car.

Seated position: The position determined by where an occupant might sit: driver, right front, center rear, and so on.

Serious and critical injuries: Injuries which, because of their nature and severity, are potentially or actually dangerous to life.

Methodology

Of all the passenger car occupants who were fatally injured, a distinction was made between those whose injuries resulted from contact with structures inside the car and those whose injuries were the direct consequence of complete ejection from the car, that is, the injuries were sustained outside the car. The 2 frequencies of fatal injury result in 2 different risks of fatality.

The following hypothesis was adopted to determine the expected risk of fatal injury for those ejected had they remained inside the car, with the other circumstances remaining unchanged. It was postulated that had the occupants not been ejected, their risk of fatality would have been equivalent to the observed risk among persons who actually remained inside the car, in corresponding seats, and under the same force conditions. Pursuing this hypothesis, data were first arranged to show the observed risk of fatality for nonejected occupants in each category of seated position and accident severity. The expected number of fatalities among persons ejected from corresponding seated positions and in accidents of comparable severity could then be obtained by using the method of observation and expectancy.

Pursuing the original hypothesis further, the expected number of fatalities among occupants of all seats and in accidents of all severities, assuming that none had been ejected, was then compared with the observed number of fatalities to establish the proportion that would have

been avoided in the sample if ejection had been controlled. The proportion thus obtained, when applied to national fatality figures, provides an estimate of the number of lives that could have been saved by preventing ejection.

Fatality Risks in Ejection

Among the 7,337 occupants of passenger automobiles involved in any type of injury-producing accident, 13.6 percent were completely ejected, and 81.6 percent remained inside the car. Information on the remaining 4.8 percent of the occupants was doubtful, and these were eliminated from the study.

In table 1, persons completely ejected are compared with persons who definitely remained inside the car, and the proportion of fatally injured persons in the two groups is shown, thus providing an answer to the question: Is the risk of fatal injury greater for ejected persons than for those who remain inside the car?

There were 9.6 percent fewer fatalities among those not ejected than among those ejected ($P<.001$). Further, the risk of fatality among the ejected was demonstrated to have been nearly five times as great as that among those not ejected: 12.1 percent for those ejected versus 2.5 percent for those not ejected. These data clearly suggest that the number of fatalities in automobile accidents would be reduced by minimizing the occurrence of ejection.

The material which follows deals with the methodology and rationale employed in predicting the number of lives that would have been saved in the sample if those ejected had not been ejected. This methodology must, of course, take into account the fact that a certain number of persons, even if they had remained inside the car, would nevertheless have been exposed to some risk of fatal injury; that is, at least the 2.5 percent risk experienced by those not ejected. Thus it must by no means be assumed that the 5 to 1 ratio seen in table 1 implies an 80 percent reduction in the total number of fatalities if ejection is eliminated. Furthermore, it also cannot be assumed that the occurrence of fatality is related exclusively to the occurrence of ejection or nonejection. Other accident-injury factors must be taken into account.

Table 1. Risks of fatal injury for those ejected and those not ejected

	Not fatally injured	Fatally injured	Total	Percent fatally injured
Ejected	876	121	997	12.1
Not ejected	5,843	147	5,990	2.5
Total	6,719	268	[1] 6,987	3.8

[1] Data on 350 of the 7,337 occupants studied have been omitted since details on ejection were not completely reported for these persons.

Accident Severity, Seats, and Fatality

As has been indicated in table 1, the risk of fatality was greatly influenced by the occurrence of ejection. In addition, the influence of at least two other major variables affecting both the frequency of ejection and the risk of fatality have been definitely established in previous research (*6*, *7*) and have to be taken into account. These factors are accident severity and seated position, both of which are believed to have sufficient bearing on the subject of this investigation to warrant particular attention.

Figure 1 illustrates the frequency of fatality in progressive categories of accident severity. Statistical analysis of the data, revealed a significant increase ($P<.001$) in risk of fatality as accident severity increased. Figure 2 illustrates the frequency of fatality among car occupants according to seated position occupied and shows that the risk of fatality was significantly different ($P<.001$) for occupants of different positions. In these two figures, in order to eliminate over-emphasizing driver injury, data on drivers alone and drivers with passengers are presented separately.

The effect of these same factors on the frequency of ejection is illustrated in figures 3 and 4. Figure 3 illustrates that as accident severity progressively increased, the frequency of ejection significantly increased ($P<.001$). Figure 4 illustrates the varying and significantly different ($P<.001$) frequencies of ejection depending on seated position. In particular, the rear seat area produced much lower risk of ejection than the front seat area. This was due

largely to the fact that about half of the cars observed were two-door models; rear seat occupants were seldom ejected through the front doors.

Observed and Expected Risks

It has been clearly demonstrated that those ejected are much different from those not ejected with respect to risk of fatality and that, further, fatality risks will fluctuate considerably according to seated position and accident severity. The available data on these three factors affecting fatality risks were used to determine the answer to the question: What would have been the expectations in terms of fatality for the ejected had they remained inside the cars?

Strictly speaking, of course, it is impossible to determine what would have happened to any specific ejected person in a single, hypothetical situation if he had remained inside the car. However, given certain reasonable assumptions,

Figure 1. Frequency of fatality according to accident severity.

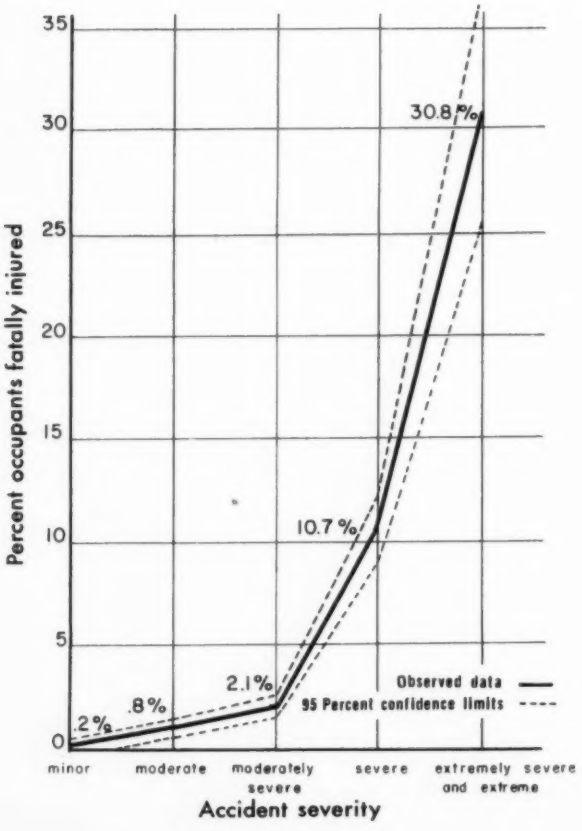
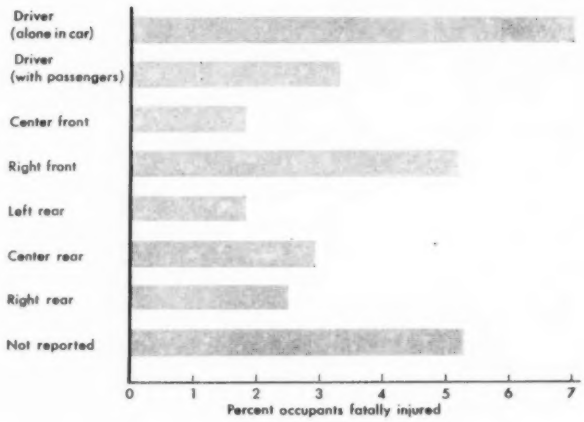


Figure 2. Frequency of fatality among all occupants of different seats.



it is possible to obtain an estimated (or predicted) number of fatalities representing the fatality risk of a category or group rather than of any individual in that category or group. Predictions under such conditions are described as expectations under a given hypothesis or, more briefly, expectations.

The volume of data on nonejected persons, 81.6 percent of the total number in this study, is sufficiently large so that the risks of fatal injury associated with given seated positions under given conditions of accident severity may be assumed to be representative for any single occupant who remains inside the car. A reasonable assumption is that the fatality risks to which a given ejected person would be exposed were he not ejected would be comparable to the fatality risk encountered by a group of nonejected occupants subjected to the same conditions of accident severity in a seated position corresponding to that from which the ejected person had been thrown. The fatality risks for nonejected persons according to accident severity and seated position can be taken directly from basic data. These observed fatality risks thus obtained provide a reasonable basis for calculating the expected number of fatalities that would have been encountered among ejected persons if they had stayed in their seats.

Calculations for Expectancies

Simple algebraic calculations, based on the rationale described above, yielded the expected number of fatalities in each category of acci-

dent severity and seated position. For example, it is shown from the data in table 2 that among 578 nonejected right front seat occupants involved in moderately severe accidents, there were 6 fatalities, while among 115 ejected right front seat passengers in accidents of the same severity, there were 14 fatalities. To calculate the expected number of fatalities if ejection had not taken place, the data were arranged as a simple ratio: the expected number of fatalities among the ejected is to the total ejected as the observed number of fatalities among the nonejected is to the total nonejected. Expressed numerically, the ratio reads, $x : 115 :: 6 : 578$.

The expected number of fatalities among ejected persons was 1.19 (or about 1 person). But among the 115 ejected persons observed, there were actually 14 killed. Thus, in the given category of seated position and accident

Figure 3. Frequency of ejection according to accident severity.

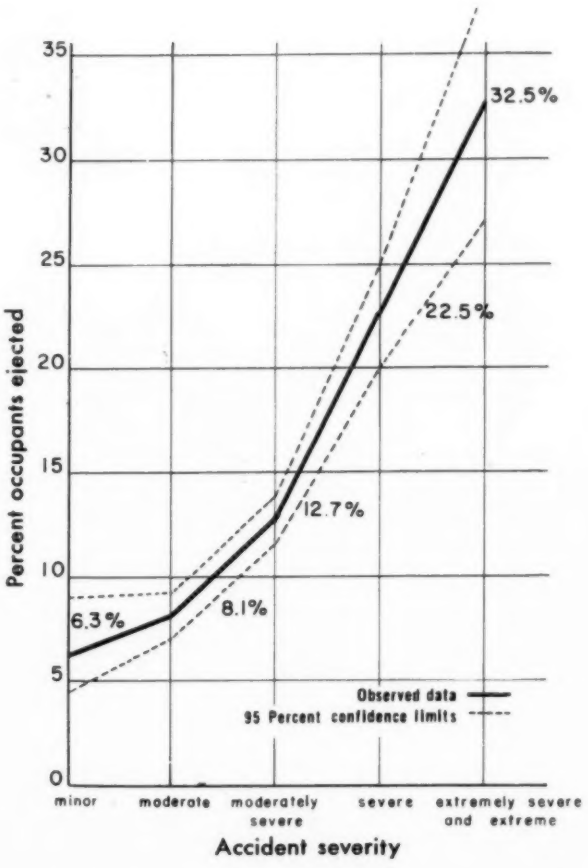
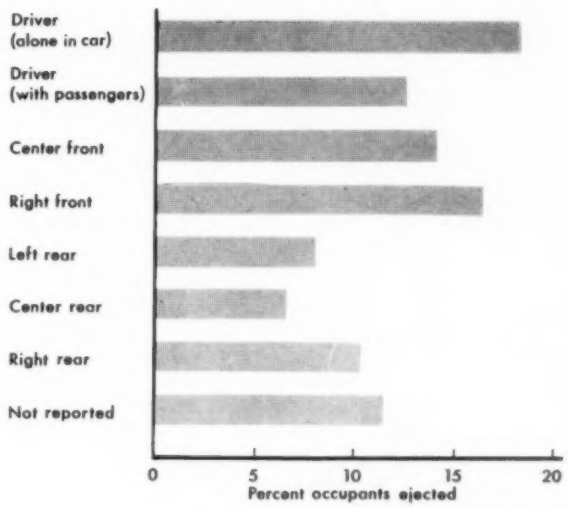


Figure 4. Frequency of ejection from different seats.



severity, there were 13 more people killed than would have been expected if there had been no difference between risks of fatality for ejected and nonejected persons.

By totaling the observed and the expected fatalities in table 2 for each seated position and within ranges of severity, and then subtracting one from the other, the basis was provided for an estimate of the number of lives that could have been saved in the 3,261 accidents surveyed if ejection had not occurred. There were 121 observed fatalities and 53 expected fatalities among those ejected, a difference of 68, therefore, between the two.

The total number of fatalities observed among all occupants, whether ejected or not, was 268. Since 147 of these were among the nonejected group, they would not be affected by preventing ejection, and the expected number of fatalities here would be the same as the number observed. Therefore, preventing ejection could have reduced the number of fatalities by 68, leaving only 200 fatalities. (The 200 expected fatalities could also have been determined in this way: 147 observed among nonejected, plus 53 expected among ejected under the hypothesis.)

This reduction, expressed as the proportion 200/268 (74.6 percent), can be applied to the national fatality figures for passenger car occupants to obtain the estimated number of fatalities that would still occur throughout the Na-

Table 2. Observed and expected fatality frequencies among those ejected, with regard to accident severity and seats occupied

Accident severity, by seat occupied	Nonejected		Ejected		
	Total persons observed	Fatally injured persons observed	Total persons observed	Fatally injured persons observed	Fatally injured persons expected
Minor	**436**	**0**	**30**	**1**	**0.0**
Driver alone	62	0	10	1	.0
Driver with passenger	122	0	5	0	.0
Center front	34	0	1	0	.0
Right front	101	0	9	0	.0
Left rear	33	0	2	0	.0
Center rear	20	0	1	0	.0
Right rear	39	0	2	0	.0
Seat unreported	25	0	0	0	.0
Moderate	**2,025**	**7**	**183**	**8**	**.63**
Driver alone	265	2	32	3	.24
Driver with passenger	609	1	42	2	.0
Center front	177	0	21	1	.0
Right front	491	2	65	2	.27
Left rear	131	0	4	0	.0
Center rear	68	1	3	0	.04
Right rear	150	0	9	0	.0
Seat unreported	134	1	7	0	.05
Moderately severe	**2,276**	**21**	**351**	**31**	**3.24**
Driver alone	329	6	70	6	1.27
Driver with passenger	680	4	100	8	.59
Center front	187	1	29	0	.15
Right front	578	6	115	14	1.19
Left rear	167	0	8	0	.0
Center rear	79	1	3	0	.04
Right rear	166	1	11	3	.07
Seat unreported	90	2	15	0	.33
Severe	**868**	**75**	**283**	**44**	**24.45**
Driver alone	126	16	62	12	7.87
Driver with passenger	241	18	76	9	5.68
Center front	76	3	22	2	.87
Right front	215	25	80	16	9.30
Left rear	62	1	8	0	.13
Center rear	40	2	4	0	.0
Right rear	66	5	16	1	1.21
Seat unreported	42	5	15	4	1.79
Extremely severe and extreme	**166**	**44**	**96**	**37**	**25.45**
Driver alone	29	14	23	9	11.10
Driver with passenger	44	9	24	9	4.91
Center front	12	2	6	2	1.00
Right front	37	14	18	6	2.27
Left rear	7	1	10	6	1.43
Center rear	9	1	4	2	.44
Right rear	12	1	7	1	.58
Seat unreported	16	2	4	2	.50
Total [1]	5,771	147	943	121	24.02

[1] Data on 623 of the 7,337 occupants in the sample have been omitted because of incomplete details. Ejection data were not fully reported for 356 persons, and accident severity information was not available for 273.

tion even if ejection were controlled (*3*). Roughly 75 percent would still occur, which means a reduction of 25 percent.

National Fatalities

The National Office of Vital Statistics reported 39,628 deaths resulting from motor vehicle accidents of all descriptions in 1956. The annual figure has been fairly constant over the past 5 years (*5*). Since these tabulations included all persons fatally injured, under whatever circumstances, in accidents associated with motor vehicles of every description, they were not all applicable to the present study, which is concerned exclusively with fatal injury to passenger car occupants. Therefore, certain eliminations were needed in order to obtain the basic applicable figure accounted for by passenger car occupants among the national fatalities.

Among the fatalities eliminated were those incurred when motor vehicles collided with pedestrians or cyclists, since fatal injuries in these accidents were more likely to have been sustained by the latter than by the occupants of the motor vehicles. The nature of the National Safety Council's tabulations, subclassified under various categories, permitted the elimination of these fatalities without difficulty (*5*).

A further elimination was required with respect to fatalities among occupants of street cars, buses, trucks, and any other vehicles which could not be classified as passenger cars. Unfortunately, the national accident fatality tabulations did not distinguish between deaths among occupants of passenger cars and occupants of other motor vehicles. However, gross figures supplied by the National Safety Council (*5*), through data collection of the National Office of Vital Statistics (*8*), provided for the estimation that about 75 percent of the motor vehicles involved in fatal accidents were passenger cars. Most of the remaining 25 percent were trucks, which normally carry fewer passengers than automobiles. Therefore, it is perhaps overgenerous to presume that 25 percent of the fatalities in these accidents were sustained in vehicles other than passenger cars.

The results of all the above eliminations may be observed in table 3.

These eliminations result in a conservative estimate of 23,678 deaths annually among occupants of passenger cars involved in accidents. Roughly 87 percent of these deaths (20,528) occurred in rural accidents; the balance of 13 percent are accounted for by accidents in urban areas. In the following section it is estimated how many of these 23,678 lives might have been saved by preventing ejection. Since the estimate of passenger car occupant fatalities is very cautious, the predicted number of avoidable fatalities may represent an underestimation. In any case, it can safely be regarded as a minimum figure.

Application of Reduction Proportion

We have estimated that prevention of ejection could eliminate 25 percent of the fatalities observed in the study sample. Before applying this percentage to the adjusted estimate of 23,678 annual deaths among passenger car occupants throughout the Nation, certain differences between the sample data and the national tabulations had to be taken into account. For example, among those national fatalities pertinent to the problem (table 3), roughly 20,000 occurred in rural areas and about 3,000 in urban areas, with the ratio of rural to urban fatalities amounting to somewhat more than 6 to 1. In the sample studied the ratio of rural to urban fatalities was about 25 to 1.

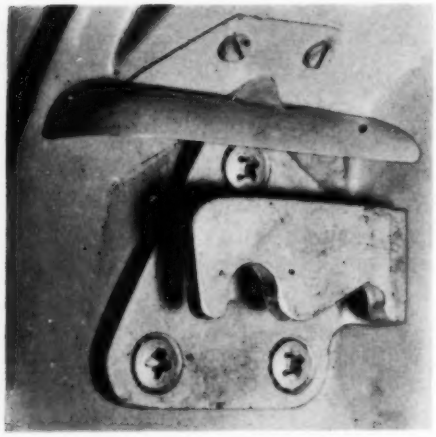
Therefore, applied to national figures, the

Table 3. Motor vehicle fatalities, 1956 [1]

Classification	Total	Rural	Urban
Total	[2] 40,000	30,400	9,600
Pedestrians, cyclists	8,430	3,030	5,400
Balance	31,570	27,370	4,200
Trucks, buses, others (25 percent of balance)	7,892	6,842	1,050
Balance (passenger cars)	23,678	20,528	3,150

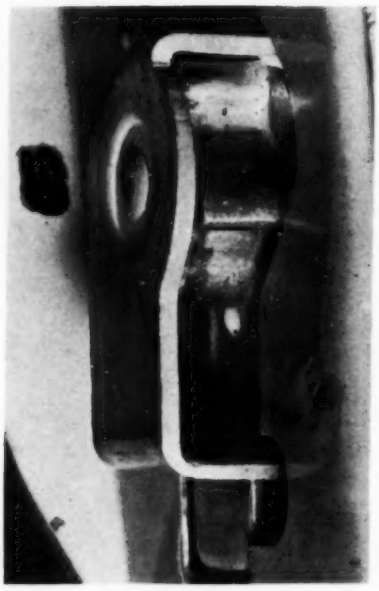
[1] Derived from 1956 fatality figures published in Accident Facts (*5*), and based on mortality data collected by the National Office of Vital Statistics.

[2] A more accurate figure (39,628) has been recently released by the National Office of Vital Statistics, but corresponding adjustments for the detailed groups in the table are not yet available.



STRIKER

Typical safety doorlock.



LATCH ASSEMBLY

STRIKER AND
LATCH ENGAGED

calculation for the percentage of reduction would have to take into account the sampling bias.

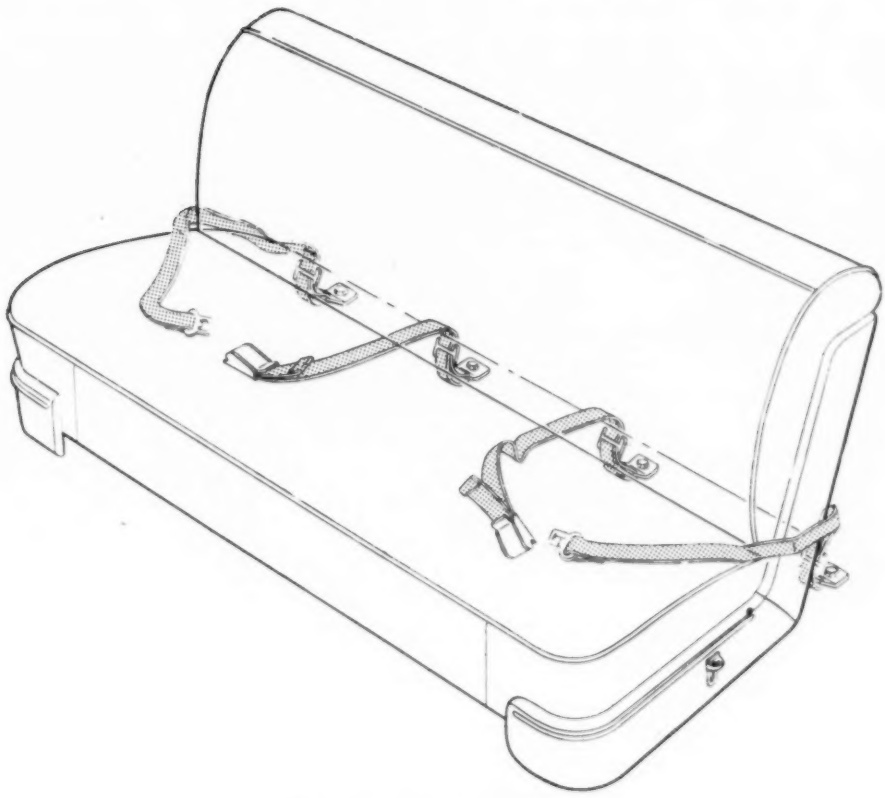
Since the sample was predominantly rural (more than 90 percent of the accidents studied occurred in nonurban areas), the estimated reduction of 25 percent could be directly applied to the 20,528 lives lost annually in rural accidents, a saving of about 5,132 lives each year. However, the full reduction of 25 percent could not be reasonably expected in urban accidents where accident conditions are frequently less severe than on rural roads. It was estimated that perhaps a 10 percent reduction could be presumed, and that about 315 of the 3,150 urban fatalities might be eliminated by prevention of ejection. Thus, a minimum of approximately 5,500 annual fatalities might be avoided in future years if the hazards of ejection were removed.

Discussion

An annual toll of approximately 40,000 deaths and more than 1,000,000 injuries (*5*, *8*) in motor vehicle accidents is truly epidemic in proportion, and is not likely to be brought under control except by preventive methods affecting a majority of the national population. Obviously, the ideal solution would be the elimination of accidents themselves, but it clearly must be assumed that a certain number of accidents will always take place. Furthermore, large-scale measures to prevent accidents may take years to develop.

If it is admitted that some accidents will always occur despite all efforts, then proper attention to the crash injury problem should include development and provision of controls that will operate to prevent injury when an accident occurs. Controls of this sort may be compared to the use in preventive medicine of serums and vaccines which protect the recipient from the consequences of exposure to infectious diseases.

It is the objective of automotive crash injury investigations to isolate and identify the specific causes of injury observed in injury-producing accidents, and to provide indications of the fre-



Typical seat belt installation.

quency, nature, and severity of injuries associated with given causes. Reliable data of this kind can guide designers and engineers toward the elimination or delethalization of specific structures found to be potentially dangerous under crash conditions.

The relationship of automobile design to injury is nowhere more apparent than in the comparison of the frequency of fatality among ejected and nonejected occupants. If doors had not sprung open during impact, occupants could not have been ejected. Even if doors had failed to remain closed, by our definition of complete ejection, no occupant wearing a fully effective seat belt could have been thrown from the car. As statistical computation has indicated, 25 percent of all fatalities among passenger car occupants can be eliminated if ejection is completely prevented. Failure to control ejection implies the loss of more than 5,000 lives each year, and these deaths can no longer be accepted as unavoidable since the means of at least partial control exists.

If occupants can be retained inside the car in future accidents, then the injury potential associated with structures within the passenger compartment can be reduced systematically with the cooperation of the automotive engineer. The use of properly designed and installed seat belts, for example, not only protects the wearer from the risks associated with ejection but also reduces the force with which he is likely to strike objects within the passenger compartment. It has been observed under controlled laboratory conditions that the restraining action of a lap-type seat belt reduces the force of head blows by as much as one-third (*9*). If objects and surfaces within the reduced striking range of a seat-belt wearer are designed to absorb energy and to distribute it over a considerable area of the contacting body, a further reduction in injury-producing force is readily obtained. Preliminary studies, utilizing a paired-comparison technique, have indicated that the use of seat belts by nonejected persons is associated with a maximum demonstrable decrease of about 60 percent in risk of all grades of injury (*2, 4*).

Additional design modifications can be sug-

gested, and new developments tested as they become available. At present, data from more than 10,000 automobile accidents are available for use as a control group in evaluating future safety designs.

Although the present report has been concerned with ejection only as it influences the incidence of fatal injuries, the importance of ejection in nonfatal injuries, particularly those that are seriously disfiguring or disabling, should not be overlooked. Unfortunately, data are not available to predict the national reduction in nonfatal injuries that might be expected if ejection should be prevented. However, there is evidence that the percentage of passenger car occupants sustaining serious and critical injuries, whether ejected or not, is roughly the same as the percentage who are fatally injured. Previously published research findings have indicated that the number of fatal injuries sustained by passenger car occupants is similar to the number of serious-to-critical (dangerous) injuries (*3*). Thus, among those persons injured nonfatally in motor vehicle accidents each year, there might be some 23,670 passenger car occupants whose injuries are in the serious-to-critical range, and whose risk of sustaining injuries of this severity is at least doubled when ejection takes place. (The calculated ratio is 2.5 to 1.) Effective prevention of ejection could scarcely fail to produce a substantial reduction in the annual number of serious-to-critical injuries.

Although it is not a function of the present research in automotive crash injuries to develop the actual devices for control and elimination of the ejection hazard, data and findings suggest the provision of strengthened door locks in currently manufactured cars, automobile seat belts, and some simple and effective device for keeping doors closed on the more than 50 million pre-1956 cars still operating today.

One serious limitation of devices such as the seat belt relates to the educational and psychological difficulties in bringing about their general acceptance and use. Inevitably, a considerable number of automobile users will show more than initial resistance. But it is believed that extensive efforts aimed at encouraging widespread use of seat belts, together with constant modification of automobile components identified as responsible for injury, will result in a significant reduction of highway casualties.

Application of the means for controlling ejection and its injurious effects is within the realm of immediate possibility. It is hoped that the goal of an annual saving of several thousand lives will provide the needed incentive.

Summary

In a sample of injury-producing accidents analyzed in the Cornell University Medical College study (3,261 passenger cars, each of which contained at least 1 injured person), 13.6 percent of all occupants were completely ejected from an automobile.

Ejected occupants of passenger automobiles had a much higher risk of fatality than those not ejected. This increase was demonstrated to be statistically significant and not due to chance.

The frequency of ejection from doors opened under crash impact conditions varied according to accident severity and seat occupied. Fatality risk was also influenced by these two factors.

Observed and expected fatalities based on a simultaneous consideration of ejection risk, accident severity, and seat occupied demonstrated that prevention of ejection from passenger cars could have reduced fatalities among passenger car occupants in the study by 25 percent.

It is conservatively estimated that about 23,700 of the approximately 40,000 lives lost annually occur among passenger automobile occupants involved in traffic accidents. Of these fatalities, about 20,000 occur in rural areas.

Elimination of ejection in passenger automobile accidents on a nationwide scale could save a conservatively estimated 5,500 lives yearly if the level of annual fatalities persists at about 40,000.

Ejection from automobiles can be prevented by the use of properly designed and installed seat belts, further refinements of the safety door lock which was standard equipment in 1956 and 1957 cars, and auxiliary devices designed to keep doors closed in older cars.

REFERENCES

(*1*) Moore, J. O., and Tourin, B.: A study of automobile doors opening under crash conditions.

New York, N. Y., Cornell University Medical College, Aug. 1, 1954.

(2) U. S. Congress, House of Representatives, Committee on Interstate and Foreign Commerce, Subcommittee: Hearings . . . traffic safety—investigation of highway traffic accidents. 84th Cong., 2d sess., July 16, 23; Aug. 8–10, 27–31; Sept. 25–28, 1956. Washington, D. C., U. S. Government Printing Office, 1957, p. 898f.

(3) Braunstein, P. W.: Medical aspects of automotive crash injury research. J. A. M. A. 163: 249–255, Jan. 26, 1957.

(4) Automotive Crash Injury Research: Annual report for the period 1 April 1956 to 31 March 1957. New York, N. Y., Cornell University Medical College, 1957.

(5) National Safety Council: Accident facts. 1952 to 1957 editions. Chicago, 1952–1957.

(6) Bross, I. D. J., and Feldman, R.: Ridit analysis of automotive crash injuries. New York, N. Y., Cornell University Medical College, October 1956.

(7) Moore, J. O.: A preliminary study of speed as related to injury-producing accidents. *In* Accident analysis and impact studies. Highway Research Board Bull. 142. Washington, D. C., National Academy of Sciences-National Research Council, 1956, pp. 11–18.

(8) U. S. National Office of Vital Statistics: Accident fatalities—United States, 1952. Vital Statistics—Special Reports, Vol. 38, No. 14, Sept. 9, 1954. Washington, D. C., U. S. Government Printing Office, 1954.

(9) U. S. Congress, House of Representatives, Committee on Interstate and Foreign Commerce, Subcommittee: Hearings . . . automobile seat belts. 85th Cong., 1st sess., April 30, and Aug. 5–8, 1957. Washington, D. C., U. S. Government Printing Office.

Advisory Committee on Radiation

A National Advisory Committee on Radiation was established by the Surgeon General of the Public Health Service February 12, 1958, to advise on programs of the Service in public health aspects of radiation.

Present Service activities in this field include research, epidemiological studies, radiation monitoring of water, air, and milk, and technical assistance to the States on safety measures.

Dr. Russell H. Morgan, professor of radiology, Johns Hopkins University Medical School and radiologist in chief, Johns Hopkins Hospital, who has been serving as special consultant on these matters, is committee chairman. Dr. Donald R. Chadwick of the Office of the Surgeon General is executive secretary.

To-date committee appointments also include: Dr. Arnold O. Beckman, president, Beckman Instruments, Inc., Fullerton, Calif.; Dr. Victor P. Bond, Brookhaven National Laboratory, Upton, N. Y.; Dr. Richard H. Chamberlain, professor of radiology, University of Pennsylvania Hospital, Philadelphia; Dr. James F. Crow, professor of genetics, University of Wisconsin, Madison; and Dr. Herman E. Hilleboe, commissioner of health, New York State, Albany.

Other committee members are: Dr. Hardin B. Jones, Donner Laboratory, University of California, Berkeley; Dr. Edward B. Lewis, professor of biology, California Institute of Technology, Pasadena; Dr. Berwyn F. Mattison, executive secretary, American Public Health Association, New York City; Lauriston S. Taylor, chief, Atomic Radiation Physics Division, National Bureau of Standards, Washington, D. C.; Dr. George W. Thorn, physician in chief, Peter Bent Brigham Hospital, Boston, Mass.; and Dr. Abel Wolman, professor of sanitary engineering, Johns Hopkins University, Baltimore, Md.

World Health Organization, 1948–1958

At the Eleventh World Health Assembly in May 1958 in Minneapolis, the World Health Organization can look in retrospect at 10 productive years, each increasingly significant to mankind. Through its growing network of activities, whether they are part of the total war against malaria, eradication of yaws, or of environmental efforts less dramatic but equally vital, WHO has left its beneficial mark in the remotest corners of the world. Also high on the list of WHO contributions is an achievement outside the realm of health: the agency has demonstrated a working design for worldwide cooperative action on a common front.

On the occasion of the World Health Organization's tenth anniversary, the following pages are devoted to papers reflecting the agency's dynamic growth and accomplishments. Additional papers will be published following the assembly.

TEN YEARS OF WHO PROGRESS

M. G. CANDAU, M.D., M.P.H., DIRECTOR-GENERAL

• THE WHOLE CONCEPT of the World Health Organization and all the principles included in its constitution are based on this simple truth: in our shrunken world, health, like peace and security, is indivisible, and mankind's fight to control and eradicate disease can be won only through the concerted efforts of all of us. Therefore, when WHO was created, arrangements were made for universal membership. Today, with 88 members and associated members, such universality has almost been obtained.

Their cooperative effort has already brought a number of benefits to all. Rapid pooling of information and experience makes it simpler to contend with diseases such as influenza and poliomyelitis, to meet the threat to mental health that grows from modern conditions of life, to adapt medical education to changing needs, and to study emerging problems such as health hazards of radiation or the mental health aspects of automation.

Countries that are struggling to conquer age-old diseases and to build up modern public health services have benefited further from the practical help given through the World Health Organization. Indeed it is for the successful fight against certain diseases widespread in the tropics and subtropics that the Organization is most widely known. Let me give you a

few examples. In the 1950–56 campaign against yaws in Indonesia, more than 23 million persons were examined and 3¼ million were treated during the initial surveys, and more than 31 million examined and 1.5 million treated during the re-surveys. In Haiti, until 1950, yaws affected almost a third of the rural population. By December 1954, a total of 2.8 million people had been treated. Observation in the southern region of the country, where the campaign had been initiated, showed that less than 1 percent of the population had contagious yaws.

Similarly with syphilis; in the Ghund Valley (Simla, India) control of this disease was achieved within a few months. When the entire population of this secluded valley was examined clinically and tested, 65 percent were shown to be positive. Penicillin was administered, and a checkup 5 months later showed that no new clinical cases had occurred.

Good results are being obtained by the use of antibiotics in mass campaigns conducted against trachoma and infectious conjunctivitis, which affect no less than 400 million people throughout the world.

Through the mass BCG vaccination campaigns (about 200 million people have been tested and around 90 million vaccinated) and the application of the new chemotherapeutic

agents, promising results are being achieved in reducing tuberculosis. As a result of action undertaken by national administrations, often assisted by WHO and other international and bilateral agencies, more than 350 million people can today be considered either freed from or protected against malaria.

Initiated or supported by WHO assistance, these campaigns have been carried out on every continent. One result is that, increasingly, babies are born to live, not to die. Increasingly, people can expect strength to live and capacity to work. In the past 10 years this great new promise has reached out to become reality to ever more millions of our fellow men.

Building Health Services

At the same time, the slower task of building up comprehensive health services is going forward in the member states with support from the Organization so that results achieved against communicable diseases can be consolidated. Most of the coordinating and leadership functions of WHO are directed towards this all-important objective. This fact is reflected in the growing development of intercountry education and training programs for medical and other health personnel and in the fact that today more than 40 percent of our projects in all regions are mainly concerned with education and training. In addition to providing assistance in the establishment or improvement of medical schools, nursing schools, and other training institutions, WHO experts and consultants are reviewing their curriculums and, what is even more important, their effectiveness in relation to local health needs. During the past years, it has been made clear that modern methods of combating disease and promoting health are useful only if their application is satisfactorily adjusted to widely differing stages of social, cultural, educational, and institutional development. Only in this way can the people for whom the measures are designed accept them and put them into practice as an integral part of their own ways of life.

It remains generally true, however, that experience gained in one area can be usefully applied in others. Seminars, conferences, and study tours arranged on a regional or interregional basis, in addition to providing inspiration and stimulus to their participants, are considered to be increasingly useful as vehicles for the exchange of scientific information and experience.

Among the conferences held during the past 10 years to promote medical education was one in New Delhi, where 132 medical education experts gathered to examine the type of training needed to solve India's shortage of medical manpower. A conference held in Chile, and attended by deans and professors from 40 medical schools in South America, discussed the teaching of preventive and social medicine. Israeli medical officers have benefited from the pooled experience of visiting public health workers. Anesthetists from many countries have been and are being trained in special courses in Copenhagen. Physicians have been instructed, also in Copenhagen, in the management of acute bulbar forms of poliomyelitis by the application of Lassen's method. Sanitary engineers have had an opportunity to further their knowledge through seminars organized at Leiden, Milan, and other places. Treponematologists have been given similar opportunities in Stockholm and Bangkok. Malariologists have received training in Amani, Bukavu, Guatemala City, Lagos, Lisbon, London, Maracay, Mexico City, Rome, and Yaoundé. Many other medical and public health workers have received similar training in a number of countries.

An even more direct form of international training is that afforded by WHO fellowships which enable public health workers to attend, for periods ranging usually from 3 to 12 months and, occasionally, for even longer periods, public health schools or specialized institutions to obtain advanced training or observe new methods and techniques, and bring back to their countries the benefit of their new knowledge. During its first 10 years, WHO awarded 6,396 fellowships. The truly international character of this program is revealed by the fact that during a 1-year period 1,100 fellows were received by 577 institutions in 42 countries. A growing number of fellowships have been devoted to studies within regions, so that fellows can obtain training and become familiar with

As a medium for the spread of medical knowledge, WHO organizes teams of specialists for international tours during which they demonstrate new techniques and report on new developments in public health. Here, a member of such a team, an internationally known surgeon, performs a demonstration operation in Cairo.

advanced techniques under conditions as similar as possible to those prevailing in their own countries.

Fellowships provide opportunity for advanced training abroad in varied subjects such as the teaching of preventive medicine, anatomy, and physiology; the organization of public health laboratories; the standardization of biologics; the medical use of radioisotopes; cell metabolism in cancer; food additives; the organization of medical education; thoracic surgery; the control of malaria, tuberculosis, venereal diseases, and congenital heart disease; psychotherapy for juvenile delinquents; psychiatric aspects of asthma; tropical architecture for health institutions; and, of course, postgraduate training in public health, nursing, sanitation, health education of the public, and similar subjects.

A great deal of effort and money has been devoted to the fellowships program—not only the effort of the countries selecting and proposing candidates and that of WHO planning and administering the individual fellowships, but also, and most important, the effort contributed by countries and institutions of study, without whose goodwill and cooperation the program would not have been possible.

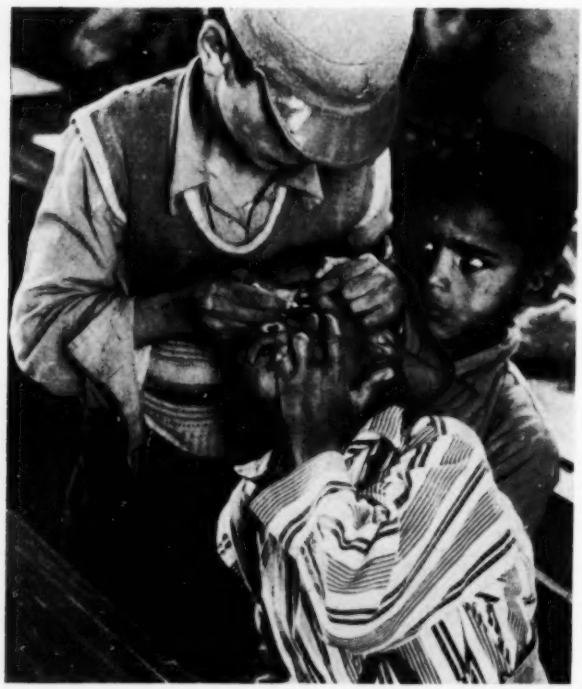
WHO Expert Advisory Panels and Committees

Expert advisory panels were established so that WHO could obtain the technical advice it needed on a particular subject either by correspondence with panel members or by inviting them to expert committee meetings. Tribute should be paid to the farsightedness of those whose idea it was to establish these panels and to those who, as members of them, have individually and collectively provided essential

technical advice for the development of the Organization's programs.

The Publications Program

It is important that the new facts obtained by scientists working under the auspices of WHO should find as wide an audience as possible, and the Organization, therefore, has emphasized its publications program. Besides the Technical Report Series (in which the reports of the expert committees appear), the program includes the *Bulletin*, which is a scientific periodical; the *Chronicle*, which contains a monthly account of work carried out under the auspices of WHO in various parts of the world; the *International Digest of Health Legislation*, which contains health legislation texts in full or in summary form; the *Epidemiological and Vital Statistics Report*, and the *Annual Epidemiological and Vital Statistics*, which contain mortality and morbidity statistics from many countries. There are also the individual books such as monographs on maternal care and mental health, plague, influenza, poliomyelitis, biology of treponematosis, meat hygiene, and toxic hazards of certain pesticides to man, to list only a few. These publications contain not only results of work undertaken under WHO auspices but also material from outside contributors concerning facts and studies which may be usefully disseminated to public health workers in all countries.



One of the features of the campaign in Egypt against trachoma, a disease usually contracted in childhood, is a pilot project run by the government with the aid of WHO and UNICEF in which school children in a selected area are taught to treat themselves with antibiotics.

The publications program forms part of WHO's worldwide services from which even the most advanced countries can benefit. These services comprise the recommendation of international standards for biological substances; establishment of specifications and the selection of nonproprietary names for the more important pharmaceutical preparations coming on the market; and control of air, land, and sea traffic from the point of view of health. The collection and study of comparable health statistics from as many countries as possible and technical advice concerning addiction-producing drugs and their control are also WHO services.

International Standardization

The publication of the first volume of the Pharmacopoea Internationalis and the adoption of the International Sanitary Regulations—both historic events occurred during 1951—are examples of the benefits which can derive from an international health organization, and which scarcely could have been achieved without it.

Approving the publication of the International Pharmacopoeia in May 1950, the Third World Health Assembly recommended "the eventual inclusion of its provisions in the national pharmacopoeias after the adoption of the said provisions by the authorities responsible for the pharmacopoeias." It is thus recognized that the International Pharmacopoeia (of which the second volume was published in 1955) constitutes only a recommendation: its specifications are not intended to be legal in any country but are intended mainly to serve for reference purposes when national specifications are established.

The specifications for pharmaceutical prep-

Senior officers of the Mexican Army direct a nationwide effort to eliminate malaria, deploying spray teams as they would troops. To reach remote villages, the spray team, like that shown above, may ride for hours on horseback—part of a veritable antimalarial cavalry.

arations published in the International Pharmacopoeia are all the more useful these days when international travel is on the increase, when one new medical advance follows another in rapid succession, and when countries want to take the maximum advantage of the therapeutic progress in other countries.

The biological standards for which WHO is responsible already cover scores of substances, and new ones come continually under review by the Expert Committee on Biological Standardization and by the research institutes charged with making assays.

The Organization has a special duty to discourage unnecessary use of drugs which are likely to produce addiction. It is the authority which advises whether a new substance is addiction producing or not, and its advice is given legal force by nations that are parties to the international conventions as set up by the League of Nations and the United Nations. WHO can, and does, issue warnings about substances liable to lead to harmful habits and recommends that appropriate safeguards be applied until it can be finally established to what extent they are dangerous to public health. For example, the Organization's continual watch on the abuse of the barbiturates, amphetamines and, more recently, the so-called tranquilizers resulted in relevant resolutions of the United Nations Commission on Narcotic Drugs.

New Sanitary Regulations

The new International Sanitary Regulations drawn up by WHO represent the first overall agreement between the countries on effective and uniform means of preventing the spread of disease across frontiers. They have reduced a confused and conflicting mass of cumbersome conventions to a single, international, legal in-

strument applied to trade and travelers. They have tested a flexible technique of acceptance of international regulations through adoption by the World Health Assembly, as a replacement for the old, slow negotiation of many separate treaties. They have achieved some measure of harmony with modern epidemiological and public health practice. And they have contributed to the abandonment of a number of questionable technical and administrative requirements.

The epidemiological intelligence service is another example of what can be achieved through international cooperation. Governments communicate regularly to WHO information concerning cases of and deaths from quarantinable diseases. This is re-transmitted by a worldwide network of radio stations at WHO's disposal. In addition to radio messages, a printed bulletin, the *Weekly Epidemiological Record*, is sent to more than a thousand quarantine and health officers in various parts of the world. More complete notifications of particular interest to certain areas are also distributed weekly in printed or mimeographed form from Singapore, Alexandria, and Washington. This system enables maritime and airport officers anywhere to institute the necessary measures of protection, without interfering unduly with international traffic.

Concerted Effort Against Disease

With present technical developments, the control of diseases has gained new impact. One may take as an example recent developments in malaria control.

Although 230 million people have been freed from or protected against malaria, further efforts to bring safety to the more than 370 million people still exposed must reckon with the fact that certain anopheline mosquitoes have become resistant to residual insecticides. The alarming growth of this problem may be illustrated by the steady increase of resistant species of public health importance from 2 in 1946 to 38 in 1956. The problem is increasing in complexity and magnitude more rapidly than progress is being made, and not a single practical solution has been forthcoming except switching from one insecticide to another.

The WHO Technical Conference on Insect Resistance, which met in Geneva during the summer of 1957 to consider an international collaborative program of research, agreed that such a program is not only urgently needed but is essential for practical solutions in the foreseeable future of the many resistance problems.

An important fact in this context is the dynamic nature of the resistance problem as opposed to the more static nature of many of the scientific and technical problems facing the world today. The problem of the common cold, for example, may not be solved within the next decade; the problem itself is unlikely, however, to become more serious on that account. The resistance problem, on the other hand, intensifies day by day, and, as a consequence, it would be irresponsible to dismiss the real possibility of a significant increase in the incidence of vectorborne diseases of man.

Since the historic resolution on malaria eradication of the Eighth World Health Assembly (1955), more and more countries have accepted the objective of eradication as the goal of their antimalaria activities and, by the end of 1957, 76 countries and territories were either implementing or planning a program of malaria eradication. Their aggregate population represents 73 percent of the total population of all countries and territories where malaria is, or has recently been, present. There is no alternative to this course since the eradication of malaria from a single country can only be partially successful unless the same result is achieved by its neighbors and the danger of reinfestation thus eliminated.

What is true of malaria is equally true of other diseases, and there are signs that a concerted international attack on tuberculosis, leprosy, poliomyelitis, influenza, rabies, and many other diseases may turn out to be not only the most efficient, but ultimately also the most economical approach to the control of these diseases.

WHO as a Coordinator

Among examples of international coordination benefiting all countries are the International Treponematoses Laboratory Center, es-

Teams working in the WHO campaign for the eradication of yaws have examined, up to 1957, more than 60 million people in tropical regions and treated some 15 million. Typical is this Nigerian child, who, 10 days after receiving an injection of penicillin, is almost completely rid of sores.

tablished with WHO assistance at the Johns Hopkins University in Baltimore, Md., and the WHO Serological Reference Laboratories in Copenhagen, Denmark, and Chamblee, Ga. These laboratories are currently collaborating with many national laboratories on a number of thorny problems with WHO as coordinator. Worthwhile results have been obtained in connection with the new treponemal agglutination test, the immunological relation between the various treponematoses, penicillin sensitivity of treponemal strains received from various WHO field projects; the production and standardization of cardiolipin antigens, establishment of standard test serums, the evaluation of antigens for the serodiagnosis of syphilis, and many other subjects of research. An internationally assisted project against endemic syphilis in Bosnia has yielded new and valuable epidemiological knowledge.

The International Salmonella and Escherichia Center in Copenhagen receives cultures for identification from all parts of the world and distributes cultures and diagnostic serums to national laboratories. The worldwide network of WHO Influenza Centers regularly examine strains of influenza virus from all countries and communicate valuable information on the types

of strains which have to be used at particular times and in particular places in the national production of vaccine.

The influenza epidemic in 1957 subjected this network to its most serious test since its inception in 1947. However, it successfully performed the functions for which it was designed with the result that further development seems justified. In just less than 3 weeks after WHO received the first news that a significant epidemic was occurring, the Organization was able to inform health authorities and vaccine-producing laboratories that the responsible virus was unrelated to all previously isolated strains and that existing vaccines were unlikely to give protection. The warning was given in time for several countries to prepare their health services to face the impending epidemic and, in some countries, significant quantities of vaccine were produced in time for use before the epidemic struck.

Because of the uncertain status of domestic animals in the epidemiology of human influenza, steps were taken early in last year's epidemic to have serum specimens collected from swine and horses in 25 countries before and after the human epidemic struck. These specimens are being examined at the WHO Influenza Centers and it is hoped that valuable information will be gained concerning the epidemiology of human influenza.

New Public Health Activities

The example of influenza shows that, even in regard to what we may call the old, traditional disease problems, it is the duty of WHO to keep pace with current scientific developments and progressively to modify its approach to specific disease problems in the light of both new discoveries and the changes which may occur in epidemiological conditions. In our struggle to achieve worldwide health and prosperity, there is no room for complacency. We must be constantly alert and ready to attack any new problem which arises.

Increasingly in the years to come emphasis will be laid on the importance of certain new health activities in which the Organization is being called upon to collaborate with governments, such as chronic diseases, occupational health, mental health, food and drug services, and the health aspects of nuclear energy. In discharging its responsibilities with regard to the health aspects of atomic energy the Organization greatly benefits from methods and techniques already evolved in other fields for the training of personnel, the dissemination of scientific information, and the stimulation and coordination of research. This experience has been carefully applied to the two main types of activity WHO is required to carry out in developing a program on health in relation to atomic energy: The first relates to the use of radioisotopes in medicine and public health: the second aims at the protection of populations against the risks of radiation. From the directives of the World Health Assembly it is clear that WHO is concerned only with the health aspects of the peaceful use of atomic energy.

Training, especially of personnel from countries new to atomic energy, is considered as one of the most important functions of WHO in this field. An initial step was taken in 1955 when the first international training course ever held on radiation protection in relation to atomic energy was organized by WHO. This was held in Stockholm with the cooperation of the Swedish Government and the United States Atomic Energy Commission, and in 1957 a similar course was given at Mol in Belgium, with the cooperation of the Belgian Government as well as with the USAEC. Both courses were attended by physicists and physicians specializing in radiation work from a number of European countries, while in the case of the Mol course representatives of some Eastern Mediterranean countries also took part. WHO has also arranged rather shorter courses for public health administrators at Saclay, France, and Harwell, England.

Activities last year included two expert committees convened for the general purpose of providing more detailed recommendations on the type of training which doctors and other health workers would require in a world in which the peaceful use of atomic energy and radiation in general is likely to take a progressively more important place. One of these

committees dealt with the introduction of radiation medicine into the undergraduate curriculum, the other with the subject of postgraduate training in the public health aspects of atomic energy.

Training of medical men in the use of radioisotopes in countries new to this application of science is a subject where WHO's system of international fellowships is particularly useful, both to introduce a fellow to the requisite techniques and to give him clinical experience. Long-term individual fellowships are also most useful in training medical men or scientists in radiobiology.

The interest of the World Health Organization in radiation and human genetics was shown by the convening in 1956 of a study group on the effect of radiation on human heredity, and the report of this group has been recently published. The genetic effect of radiation is of course one of the factors to be considered in the disposal of radioactive waste or in the possible effects on populations of the widespread use of medical irradiation, and is therefore of direct concern to public health administrators.

The Future

During the first 10 years, the World Health Organization has fulfilled international tasks taken over from its predecessors; but it has also undertaken a program towards a healthier world beyond anything previously attempted. Together with other international agencies, WHO has helped reduce the gap that separates the people of the well-to-do countries from their less fortunate brethren. It has carried on and enriched the tradition of the universality and humanitarianism of medical science, and its modest achievements have at least shown some of the possibilities opening up for good and effective international health cooperation.

We realize, however, that much more is urgently needed before the whole world may enjoy the degree of health protection that is available to an increasing yet still far too small segment of mankind.

Manila Meeting on Social, Preventive Medicine Teaching

Deans of medical schools and professors of social and preventive medicine in Western Pacific countries met at the University of Manila during 2 weeks of October 1957 to discuss the teaching of social and preventive medicine to undergraduate students. Represented in the study group, which was sponsored by the World Health Organization, were Australia, Cambodia, China (Taiwan), Fiji, Hong Kong, Japan, New Zealand, Singapore, the Philippines, and Vietnam.

As stated by the group, social and preventive medicine courses should make students aware of social needs in medical services and of the role of social organization in the genesis, course, distribution, prevention, and treatment of disease.

Several recommendations emanated from the conference: the teaching of social and preventive medicine, which must vary according to the country's needs, should have a practical approach. Courses should extend throughout the medical curriculum and retain some traditional public health material. In research, applied and fundamental studies should be balanced.

Advantage should be taken of opportunities to teach through local health centers, teaching hospitals, and other community resources.

The medical school should teach comprehensive health care by using existing services of the government or other agencies, and under some circumstances, by using their own health clinics.

A full report will be issued by the study group.

WHO *contributions* to CHILD HEALTH

JESSIE M. BIERMAN, M.D.

MARTHA M. ELIOT, M.D.

FROM THE TIME that the Technical Preparatory Committee established by the United Nations met in Paris in March 1946 to prepare a draft constitution for the World Health Organization, it was a foregone conclusion that one of the major purposes of the World Health Organization would be to promote the development of maternal and child health programs, with national agencies and with other international organizations cooperating to this

Dr. Bierman, who served as chief of the Maternal and Child Health Section of the World Health Organization in Geneva during 1956–57, is professor of maternal and child health, University of California School of Public Health. Dr. Eliot heads the maternal and child health department of the Harvard School of Public Health. She has served as assistant director-general of the World Health Organization and as chairman of its Expert Committee on Maternal and Child Health.

end. Two clauses in the proposals of that committee made this quite clear.

In the preamble, after defining health and setting forth a series of declarations with respect to the rights of individuals to health, the responsibilities of States and related truths, the preparatory committee proposed inclusion of the statement, "Healthy development of the child toward world citizenship is of paramount importance." This proposal both in the committee and on the floor was submitted as part of the draft constitution to the International Health Conference, held in New York in June and July 1946.

During the discussions at this conference this proposal became the subject of active debate in committee and in plenary sessions. As a result the words which were obviously subject to disagreement—"toward world citizenship"—were dropped, and, instead, a new phrase was substituted to express the primary intent of the original language, namely, that all children must develop the ability to live harmoniously with their neighbors and with all peoples throughout the world. Because of the importance of this concept to all the world today, it is desirable to state here the language as it was finally adopted by the International Health Conference and made a permanent part of the constitution of the World Health Organization. The sixth clause of the preamble says: "Healthy development of the child is of basic importance; the ability to live harmoniously in a changing total environment is essential to such development." Fortunately, also, since preambles are sometimes thought of as aspirations only, the framers of the constitution included in the list of functions of the Organization the same concept in words calling for action. Here the words are: "To promote maternal and child health and welfare and to foster the ability to live harmoniously in a changing total environment."

It should be remembered that this constitution was adopted in July 1946, only a few months after the first atomic bomb had been dropped on Hiroshima. In presenting arguments for the adoption of this reworded clause for the preamble, Dr. Brock Chisholm, the delegate from Canada, pointed out the complete change in the situation in the previous 2 years.

Dr. Chisholm went on to say: "The environment of every person in the world now is the whole world; and it is essential to the health of every individual that he develop beyond the capacity to live with his own kind of people in his own little environment and be able to live with all kinds of people all over the world."

He continued: "This is not a social or an educational concept. It is a health concept, because no person who is incapable of doing this will in the future be able to live at peace with himself—because over the radio, through newspapers, by movies, he is brought into immediate contact with everything that goes on all over the world, and he must be able to live in harmony with these things in order that he may not suffer the results of frustration of his own gregarious instinct. . . . It has been necessary for every organism to be able to change and adjust to a changing environment throughout all time. If man proves unable to make this adjustment, he will follow the dinosaur into oblivion and will become completely obsolete."

When he supported Dr. Chisholm's proposed new wording, as indeed many delegates did, Dr. Frank Boudreau, speaking for the United States, expressed the hope "that the World Health Organization would undertake as soon as possible a program of work designed to achieve its objective."

It was with this as a frame of reference, then, that the work of WHO in the field of maternal and child health got started. The first steps were taken by the Interim Commission, which had been established to act until enough countries ratified the new constitution to bring the World Health Organization itself into existence. The first proposals were to pick up the type of activity that had been carried out by the Health Organization of the League of Nations, namely, studies of infant mortality.

However, by January 1948, before these studies could be begun, more comprehensive proposals for a new maternal and child health program to be undertaken by the World Health Organization were already under consideration at the fifth session of the Interim Commission in anticipation of the First World Health Assembly which was expected to be held the following June. Substantial interest had been growing among members of the commission in

a program of maternal and child health that would be more in keeping with the intent of the constitution and that would lay the ground for cooperation with many countries.

By January 1948, it had also become clear that the World Health Organization would have an increasing responsibility to provide the professional and technical help required by United Nations International Children's Emergency Fund in connection with its programs in the child health field. A comprehensive plan for the development of a maternal and child health program (*1*) over the next few years was therefore laid before the Interim Commission. Its warm reception resulted in maternal and child health being placed in the priority list of recommendations for program action second only to malaria, which was well known to be the world's greatest killer. In the introduction to its proposal, the Interim Commission said:

"An international programme for maternal and child health is recommended in view of the high incidence of preventable deaths among infants and mothers in large areas of the world; the effectiveness of available techniques in reducing mortality and improving the health of infants and mothers; the immediate and continuing need, for the protection of coming generations, of scientific guidance in the utilization of available foodstuffs; the high incidence of communicable and other preventable diseases among children; the widespread mental and emotional maladjustment and insecurity among children and youth; the insufficient understanding and knowledge among parents and others of the causes of ill-health and abnormal behavior of children; and the effects of economic and social changes on the physical, mental and emotional development of children."

The objectives of the proposed program were:

"To assist governments in developing services and facilities that will assure adequate maternity care, the best possible chance of survival to infants, and to all children normal physical growth and development, mental and emotional health, and freedom from preventable diseases; to pool knowledge, acquire new facts, develop standards of care, and distribute information in respect of all relevant matters; and to cooperate with other agencies on joint undertakings which apply knowledge and techniques in the fields of social and biological sciences and of education to problems of maternity and childhood."

The commission recommended the establishment of a section on maternal and child health as a part of the WHO Secretariat, the establishment of an expert advisory committee on maternal and child health, and the employment of individual experts and teams on a temporary basis as required.

The First World Health Assembly, when adopting in July 1948 its program for the first year's work, included maternal and child health among the four top priority programs, and instructed its executive board to take the steps necessary to implement the commission's recommendations. The story of the work for children done by this and other sections of WHO is described later.

Reference must be made here, however, to the establishment of UNICEF and to the effective collaboration that gradually developed between the Fund and WHO, particularly with the Maternal and Child Health Section. Fortunately for the world's children the General Assembly of the United Nations decided in December 1946 to create a fund to which governments and people would contribute voluntarily for assisting children in war-devastated countries with food, clothing, and medical supplies, for training personnel, and for child health purposes generally. That this new organization must necessarily collaborate with WHO and other appropriate specialized agencies of the United Nations was foreseen by the General Assembly.

The resolution under which UNICEF was established provided that the Fund should be primarily responsible for making available equipment and supplies and for assisting with training, but that it should look to the specialized agencies, especially to WHO, for the technical help and assistance required by countries seeking assistance for the development of their child health and welfare programs. It became necessary very early for these organizations to develop methods of cooperation that would assure satisfactory relations with governments and with each other.

A Turkish mother soon to have her ninth child is shown here receiving prenatal care for the first time. Set up with the help of WHO and UNICEF, the mother and child center in Ankara is now carried on by the national staff.

In July 1948 the First World Health Assembly, recognizing that certain difficulties in the relationships between the two organizations had arisen and might continue unless a framework for appropriate and continuous cooperative action were set up, recommended the establishment of a Joint Committee on Health Policy to be composed of members of the executive boards of the two organizations. Later in the same month these executive boards, meeting simultaneously in Geneva, Switzerland, adopted essentially similar resolutions creating the Joint Committee on Health Policy of the two organizations.

In brief, the functions of this committee are to approve all health programs through which UNICEF proposes to meet the requests of countries for assistance and to review these programs from time to time with a view to their evaluation. The committee also assures that the organizations are continuing to work cooperatively to the end that children the world over will receive the best health care possible under the circumstances in the country seeking help. The health programs that have been approved for joint projects fall into three groups: (*a*) mass health campaigns, such as those for control or eradication of malaria, tuberculosis, yaws and other treponematoses, trachoma, and leprosy; (*b*) maternal and child health (or welfare) programs, including establishing, equipping, and providing supplies for

maternal and child health centers, training personnel for this type of work, and providing personnel for demonstrations of newer methods of health work with mothers and children; and (*c*) certain of the food conservation programs, which are carried out largely in collaboration with the Food and Agriculture Organization of the United Nations.

In the past 10 years of their collaboration, these two great international organizations have assisted in the development of many different types of programs that affect the health and well-being of millions of children and mothers in many parts of the world.

Broad Scope of MCH Programs

The mass campaigns against the major communicable diseases and programs to improve the sanitation of the environment are of basic importance to the health of children. But much more is required than the stilling of epidemics. To achieve the stated objectives, it is necessary to reach and to serve the individual child and his family on a continuing basis. This requires some kind of permanent organization in the field and large numbers of trained personnel. At best, this is a painstaking and costly process and it takes time, not only to train personnel but to build services and to gain acceptance and cooperation of the people served. To be most effective MCH services need to be an integral part of general health and medical services of the community, and in many areas of the world such services are in the very early steps of development or are still nonexistent.

During the earlier years, many maternal and child health centers were established on too specialized a basis in advance of general public health development. But there is now increasing recognition that in the developing countries, maternal and child health should not be considered so much a specialty as a medium through which general health measures can reach two large groups in the population having certain special needs in addition to those shared by all. Children under 15 years of age and women of childbearing age constitute between 60 and 65 percent of the population in most of the assisted countries. Because of the prevalence of endemic diseases and malnutrition, purely preventive services focused primarily on the reproductive and growth processes are neither possible nor desirable. But the thousands of MCH centers which have been established as a result of WHO and UNICEF assistance offer unequaled opportunities to combine preventive and simple curative services with health education and provide focal points for activities in home sanitation, nutrition, and communicable disease control for families.

The amount of funds and the size of the staff in the WHO Secretariat entrusted with this gigantic responsibility have been very small. Positions have been provided for two MCH physicians at headquarters and in the vast region of Southeast Asia and one in each of the remaining five regions. In 1956 approximately 11 percent of WHO and UN technical assistance funds expended in the assisted countries were specifically earmarked for maternal and child health (*2*). Maternal and child health, nursing, including midwifery, and nutrition services combined account for roughly one-fourth of the funds expended in the assisted countries, or about $1.6 million. During this same year, UNICEF assistance to the building of permanent services in the MCH field amounted to $3.4 million, or about 18 percent of the program allocations (*3*).

As previously noted, most of the assistance in maternal and child health is of a joint nature with WHO responsible for providing professional staff and technical guidance and fellowships for professional training and UNICEF the necessary equipment, supplies, transport, and training stipends for local auxiliary personnel. In terms of funds then, the assistance from the two agencies has amounted to less than $5 million a year, but it must be borne in mind that the assisted countries have expended far more than this as their share of the cooperative effort.

What follows is an account of some of the contributions which WHO and UNICEF have been able to make in assisting governments of some 50 countries in the development of health services for mothers and children. In these countries live above one-half of the children of the world. The vast majority of them live in areas where the infant and childhood mortality rates are at levels which prevailed in the

more developed countries a hundred or more years ago. The principal child health problems are the result of undernutrition and malnutrition combined with an endless procession of infectious and parasitic diseases. Underlying these are poverty and ignorance and a generally unsanitary environment.

MCH Assistance Matches Development

There has been no uniform plan of MCH assistance. In countries with minimal educational and health facilities, few professional health workers, and high prevalence of endemic and communicable diseases, the mass disease control campaigns have had high priority in the beginning. The first MCH assistance has often centered about improvement of any existing, voluntary services. This is followed by the establishment of training facilities for auxiliary MCH workers; simple measures for improving the services of traditional birth attendants, or untrained midwives; and extension of preventive services, especially in maternity care, to new areas as personnel are trained. Fellowships for study abroad have provided a nucleus of professionally qualified doctors, nurses, and midwives. Then, as rapidly as possible, training schools for professional nurses and midwives are established.

A later phase of assistance is the planning and establishment of a permanent health organization to consolidate the gains made in the mass campaigns and to provide a framework for the extension of preventive and curative services and health education. It is in this stage that maternal and child health has made a great contribution to general public health, for it is commonly the first of the permanent preventive health services and forms a nucleus around which general community health programs can be built. In the region of the Americas, emphasis has been on strengthening MCH services as a component part of general health projects.

In the majority of assisted countries at present, basic minimal services are being extended to rural populations as rapidly as possible, and at the same time, professional training is being stepped up so as to provide more adequate numbers of professional personnel for supervision of the ever-increasing numbers of local centers and for leadership within the countries.

A small group of the assisted countries, such as Austria, Italy, and Spain, have achieved virtually full coverage of the population by basic health services including maternal and child health. Their infant and maternal mortality rates are relatively low. In these, the requests for assistance are in connection with the development of services for prematurely born infants, the rehabilitation of physically handicapped children, the prevention of childhood accidents, and in the promotion of mental health. The assistance has been in the form of travel fellowships, seminars and inservice training courses, short-term services of experts, and the provision of equipment necessary for establishing programs in these special fields.

Between 1947 and 1956, some 600 WHO fellowships were awarded for study abroad of various aspects of maternal and child health. The majority have been awarded to physicians, but nurses, midwives, and a few other categories have been included. The fellows came from 44 countries and territories and studied in 27 different countries.

International personnel have been assigned to 34 countries to assist the governments in establishing or improving their own training institutions for nurses or midwives. And medical schools in 10 countries have had help in establishing or upgrading departments of pediatrics. Assistance in pediatric education can be expected to increase as the UNICEF Executive Board has recently approved the extension of its assistance to medical schools for the training of physicians in pediatrics and preventive medicine. The first of these joint WHO and UNICEF projects is the one at the University of Madras, India. The pediatric department is envisaged as a focal point for the teaching of pediatrics to nurses and midwives as well as physicians, for continuation education for MCH field personnel, for graduate training of pediatrics instructors and for research on the important child health problems of the country.

Assistance has also been given to the All India Institute of Hygiene and Public Health in Calcutta where an MCH unit has been es-

tablished to provide graduate training in MCH for physicians and nurses, with emphasis on the child health aspects. The institute is now training students from a number of countries in Asia. Continued progress will demand more opportunities of this kind for MCH physicians to receive training in general public health and the administrative aspects of MCH as well as in obstetrics and pediatrics.

Service and training functions are combined in the MCH demonstration and training projects, 40 of which have been established in 29 countries. In these, WHO has provided a team consisting of an MCH medical officer and usually one or more public health nurses and midwives. The team works with personnel provided by the government. They establish an MCH unit to demonstrate services appropriate for the area and to provide training for auxiliary MCH workers and orientation and refresher courses for professional personnel.

In many of the countries the great majority of deliveries are attended by untrained traditional birth attendants. Training programs have been established in several countries with WHO–UNICEF assistance to bring about a much needed improvement in the practice of these attendants, the program in the Philippines being to date the most extensive and successful. More than half of the estimated 6,000 attendants have had some training.

An essential feature of all of these training plans is that government counterparts work closely with the international personnel and carry on after the withdrawal of the latter which takes place after 2 to 4 years. The physicians, nurses, and midwives who have been assigned by WHO to these training projects have come from all parts of the world. An MCH team working in India may have a physician from Mexico, a nurse from New Zealand, and a midwife from Sweden. While in the early years, the personnel were recruited principally from the United Kingdom, northern Europe, and North America, many other countries are now able to provide personnel with the requisite training and experience to serve in these posts, adding substantially to the international character of the programs.

There can be no question but that international aid has given a tremendous stimulus to the training of health workers—1,500 nurses and more than 2,000 midwives in a year's time in India; 650 midwives in Korea; 69 health visitors in Syria; the first class of 11 community midwives graduated in Libya; and 10,000 rural auxiliary nurse midwives in Turkey by 1970. A large number of new training schools and field training units have been established. The enrollments for both professional and auxiliary workers have greatly risen, and refresher courses and inservice training programs are increasing. Educational standards for the professions have been raised. The status of nursing as a career for women has improved. And as a result of the increased numbers of professional and auxiliary health workers, it has been possible to establish thousands of new centers in areas where MCH services have never before been available.

Growth of National MCH Units

A central purpose of all WHO assistance is the strengthening of national health administrations. An evidence of progress in this respect, as well as increasing recognition of the importance of maternal and child health, is the creation of MCH units in national health administrations. Twenty-eight of the 53 governments which have had maternal and child health assistance from WHO have established such units or have plans to do so shortly. Twelve of these have been established within the past 5 years.

The functions of the units vary widely, as do the number and qualifications of the personnel. In many instances, the staff consists of only one medical officer, who serves as adviser to the national administration and has certain limited administrative functions. In several Asian and Latin American countries the staff is larger and is able to assume responsibilities for program development and to provide technical supervision of MCH activities.

There are a few countries now in which well-qualified public health workers are not being fully utilized because the governments have been unable to establish the positions for which the personnel were trained.

In addition to direct assistance to governments, WHO has other responsibilities dele-

In the fight against infant mortality, WHO-trained public health nurses score their first victories when they establish confidence and cooperation. Here, such a public health nurse visits a family living in Chorrera, Panama.

gated to it by member governments and the United Nations. These include coordinating and regulatory functions; collection and distribution of information; pooling of health knowledge, skills, and resources of member countries; and conducting investigations. For want of better terms, these are often referred to as central technical and advisory services. Many of the services rendered by the various headquarters sections make important contributions to maternal and child health. Among them are the statistical services, studies and surveys of nutritional problems and of specific diseases affecting children, mental health, and health education.

Among the chief functions of the MCH Section are the servicing of the expert panel and expert committees in maternal and child health, the convening of study groups, the conduct of surveys and studies, the development of long-range plans for the MCH program of the organization, and cooperating with other United Nations agencies and with nongovernmental organizations concerned with international programs for children.

There are at present 42 experts from 20 countries on the MCH panel. They include leading authorities in such special fields as prematurity, nutrition, mental and school health, rehabilitation, pediatric and obstetric education, and MCH administration. Other expert panels, such as those in nutrition, mental health, and nursing, also deal with problems of concern to MCH. Through the panel system, the organization has at its command a great wealth of knowledge and skills which it is able to call

on at all times for advice and assistance in the determination of policy and on specific matters.

From time to time expert committees of panel members and less formal study groups are convened to study and make recommendations on specific topics. This process of synthesizing existing knowledge on leading problems and making the results widely available through technical reports is a contribution of great importance. A list of subjects most directly bearing on MCH will serve to indicate the broad scope of the problems which have been considered to date (the numbers represent the WHO Technical Report Series designation): maternity care (51), midwifery training (93), prematurity (27), immunization (6, 61), nutrition (44, 72, 97), mental health (70, 75), physically handicapped (58), epilepsy (130), school health (30), MCH administration (115), childhood accidents (118), and pediatric education (119). Many other reports, particularly those dealing with specific diseases affecting children, have also made important contributions to child health.

Several monographs in the MCH field have reported on studies carried out, in various parts of the world, on behalf of WHO (*4–8*).

In addition to the influence of the published reports, the bringing together of experts and research workers from various parts of the world has had a great influence in focusing attention on unsolved problems, in stimulating research, and in advancing knowledge more rapidly than has heretofore been possible. A good example is the rapidity with which knowledge has accumulated concerning protein malnutrition in children since 1949. Through a combination of WHO-FAO Joint Expert Committee meetings, field surveys, and the bringing together of research workers from all parts of the world under the auspices of the Josiah Macy, Jr., Foundation, protein malnutrition has come to be recognized within a very few years as one of the most widespread public health problems in the world.

WHO has sponsored two surveys of pediatric education, one in Latin America and the other in the countries of western Europe. The latter was carried out under the auspices of the International Pediatric Association. The convening of a study group on pediatric education in 1956 followed the completion of the surveys. These efforts are part of long-range plans to bring about improvements in pediatric education.

Two reviews of WHO–UNICEF assistance in maternal and child health have been carried out by the staff. The last one was presented to the Joint WHO–UNICEF Committee on Health Policy in 1957 (*5*). The committee has requested that reviews of certain aspects of the assistance program be presented every other year, thus establishing a pattern of continuing evaluation. If properly supported and well conducted, these evaluation studies will have great influence in guiding the two agencies and the assisted governments as well. This is but one evidence of the growing recognition on the part of both WHO and UNICEF of the need for evaluation of the programs which have grown so rapidly in the past few years.

Long-range plans have been developed for studying a number of MCH problems of worldwide significance. Included are the diarrheal diseases which account for the largest number of deaths of infants and young children in most of the developing countries. The epidemiological, clinical, and bacteriological aspects will be studied with a view to defining more clearly the environmental and host factors which must be considered for practical control in the assisted countries. In the region of the Americas, technical discussions and country seminars on diarrheal diseases have been held and field studies are under way to determine the feasibility of teaching auxiliary field workers techniques of combating dehydration, the immediate cause of death in infant diarrheal infections.

Other studies under way are concerned with a reevaluation of present criteria for prematurity, practical approaches to school health in developing countries, methods for strengthening nutrition services in MCH programs, and methods for improving the preparation of midwives for services to children.

The incomparable opportunities for research in the international aspects of MCH have so far been little exploited by WHO. A few subjects which suggest themselves are the differences in growth and development patterns of children in areas with different child feeding and rearing

practices; the influence of long-established traditional child-rearing practices on mental health; and the effects on mental health of the profound changes in every aspect of life which are resulting from rapid technical development.

As international activities increase, the need for coordination of efforts grows. This has been particularly true for the several United Nations agencies, most of which serve children in some way. Excellent cooperative relationships have developed among agencies working on common projects as exemplified by the WHO–UNICEF partnership in MCH assistance programs, WHO–UNICEF–FAO collaboration in nutrition projects, and the WHO–UNESCO study of teacher education in health.

Several nongovernmental international agencies interested in MCH are affiliated with WHO, an arrangement which facilitates cooperative relationships and endeavors. The joint sponsorship of the survey of pediatric education with the International Pediatric Association and the close relationship with the International Union for Child Welfare are examples. In time, it is likely that these coordination functions will become increasingly important.

Never before have opportunities been afforded health workers from most of the countries of the world to meet together, to talk over common problems, to share experiences, to learn from one another, and to arrive at agreements on common goals. In the course of a year there are innumerable opportunities for such interchange offered under WHO auspices—from the World Health Assembly itself and the associated technical discussions involving persons from all member countries, to small seminars and inservice training sessions for local health workers within the countries.

A better understanding of the nature of the health needs of mothers and children and of methods for dealing with problems give administrators courage to deal with the many obstacles in the way. Leaders in MCH benefit from opportunities to keep up to date and to grow in confidence and in professional competence. And for staff workers, confronted every day with sick, malnourished mothers and children, with inadequate funds and staff, and often with little community appreciation or understanding of their work, the opportunity to meet occasionally with confreres with similar interests and problems provides much needed encouragement and refreshment. It may well be that the widespread opportunities being afforded for the exchange of ideas will, in the long run, prove to be a greater force in the solution of the world's health problems than advice from experts and supplies and equipment.

It appears justifiable to conclude that substantial contributions to child health have been made during the first 10 years of the existence of WHO and UNICEF. While in most of the assisted countries, only a bare beginning has been made toward reaching the objectives set forth by the Interim Commission, it is, nevertheless, a sound beginning. In order that children can learn to "live harmoniously" in their environment, it is necessary first that they live. It is understandable then, that the major effort in a large part of the world has been directed to this end and to laying the groundwork upon which—as time and resources permit—can be built those services which will promote the health of children in the broadest sense.

REFERENCES

(1) World Health Organization: Minutes and documents of the fifth session of the Interim Commission. Official Records No. 7, annex 47, maternal and child health programme. Geneva, 1948.

(2) World Health Organization: Financial report, Official Records No. 78. Geneva, 1956.

(3) United Nations Children's Fund: Report of executive board. E/ICEF/353. New York, N. Y., 1957. Mimeographed.

(4) Bovet, L.: Psychiatric aspects of juvenile delinquency. World Health Organization Monogr. Series No. 1. Geneva, 1951.

(5) Bowlby, J.: Maternal care and mental health. World Health Organization Monogr. Series No. 2. Geneva, 1951.

(6) Fulton, J. T.: Experiment in dental care. World Health Organization Monogr. Series No. 4. Geneva, 1951.

(7) Brock, J. F., and Autret, M.: Kwashiorkor in Africa. World Health Organization Monogr. Series No. 8. Geneva, 1952.

(8) Jeliffe, D. B.: Infant nutrition in the subtropics and tropics. World Health Organization Monogr. Series No. 29. Geneva, 1955.

(9) World Health Organization: Review of maternal and child health activities and related training of professional and auxiliary health workers. WHO–MCH–64. Geneva, 1957. Mimeographed.

NURSING AROUND THE WORLD

VIRGINIA ARNOLD, R.N.

PEOPLES throughout the world are waking up to the fact that good health is their right, and their demands for wider and improved health services have shaken us out of our complacency and have forced changes in outmoded systems of health services. Nursing has been caught up, too, in this demand for better care. Much of the progress in nursing in the past 10 years has been effected by the nurses themselves, but no small part is due to the demands and the push from society.

How can the progress of nursing be demonstrated and evaluated? Would it give you a true picture if I listed the newly established schools of nursing in the Middle East, the Far East, and in Latin America? Would it help you to know that many more girls are entering nursing than at any other time in history? Would the picture be clearer if you knew that more nurses' associations have become members of the International Council of Nurses? I could describe other items of a more or less

Miss Arnold is assistant director for medical education and public health for the Rockefeller Foundation, New York City. *This article is based on an address given at the 1957 meeting of the American Public Health Association, November 14.*

statistical nature that have a bearing on the progress of nursing, but of more importance are certain events with significant implications which more clearly mark the progress of nursing in the past decade.

Nurses Recognized As Essential

Of a tangible nature is the establishment of the World Health Organization and the technical assistance programs of the United States Government and of the Colombo Plan, to mention a few. These are things we see and read about and provide funds for. There is, however, one tremendously important but intangible event that, in my opinion, constitutes the most significant development in nursing. This needed no treaties, no funds, no agreements—it simply happened because it was inevitable. It is the recognition of the essentiality of nursing in providing health services for the people of the world. To be sure, we have always said that nurses were needed in hospitals, in public health programs, in industry, and in other areas. But only recently has the nurse been recognized as essential in the development of adequate health services if the peoples of the world are to be served adequately. There is considerable evidence to support this now accepted fact.

We know that the development of nursing in any country is limited to a great extent by the state of development of that nation's medicine and public health. However, as the World Health Organization Expert Committee on Nursing has stated, in countries where medicine is highly developed and nursing is not, the health status of the people does not reflect the advanced stage of medicine. Nursing, therefore, becomes essential to the vitalization of any health program.

In 1948, at the meetings of the First World Health Assembly, only one country included a nurse as a member of its delegation. Eight years later at meetings of the same agency, 20 countries sent a nurse as a member of the delegation. This is a momentous change and a challenge to nursing.

In 1949 the United States included a nurse as one of the three advisers to the United States delegation to the meetings of the United Nations Commission on the Status of Women, held in Beirut, Lebanon. Since those meetings, whenever the agenda of the United Nations Commission on the Status of Women included items on the health of mothers and children, either a nurse has been a member of the United States delegation or a nurse's advice on agenda items was sought. The United Nations Commission on the Status of Women has also given support to nursing in member countries.

At the Ninth World Health Assembly in 1957 the theme of the technical discussions was "Nurses: Their Education and Their Role in the Health Programs." Preliminary reports on which these discussions were based were received from 33 countries, and all members of each country's health team participated in the preparation of the papers and in the discussions. From the many significant statements in the final report of these discussions, one or two will suffice as evidence of the essential role of the nurse. One statement says that "all countries recognize the need for post-basic study for graduate nurses so that they are prepared to hold positions as nursing administrators, supervisors of nursing services, teachers in schools of nursing and for certain clinical specialties." In other words, it is recognized that nurses can and must assume the responsibilities for nursing.

Another entire section deals with conditions which limit the effectiveness of nursing service in the health program. It is significant that the member countries recognized the need to study those conditions that detract from the concept of the essentiality of nurses and those that can be changed.

In May 1957 the International Council of Nurses held its Eleventh Quadrennial Congress in Rome. This is really not an unusual event, since these congresses are usually held every 4 years. But it is important that 9 new countries were admitted to full membership and 5 countries were admitted as associate members. Thus nursing representatives of 51 countries gathered to share experiences and to speak for nursing. At this congress the report of the WHO technical discussions of 1957 was cited constantly as an authoritative source, and many

Visiting nurse aide explains simple rules of health to a family in Brazil.

were the reports of changes based on the recommendations in the WHO report.

Growing Responsibilities

And, with regard to the matter of nurses' speaking for themselves, in many countries a nurse has been appointed to a position of responsibility in the Ministry of Health. In two countries, Sweden and Finland, nurses are members of parliament.

Let's look at the Middle East for a moment and note some of the changes in that part of the world.

The School of Nursing of the American University of Beirut inaugurated a postgraduate course in public health nursing in 1954. The graduates of this course have already influenced public health nursing practices in the surrounding Arab countries. But, in Iran in 1951 nursing was in a sad state. The quality of nursing education was poor; services were lacking or inadequate; and the midwife enjoyed a prestige far beyond that of the nurse. In the past 2 years, there have been some notable changes, demonstrated most dramatically by the shift in status of the midwife vis-a-vis the nurse. Now midwives are asking for the opportunity to obtain their basic nursing training so that they can compete more favorably with nurses and nurse-midwives. In 1956, Iran held its first nationwide conference on nursing, inviting to it internationally known leaders in nursing. At this conference, for the first time, the Iranian nurses took a good look at their professional position and, as a result, drew up plans for legislation, educational standards, and organization of nursing services.

In Jordan, within a period of 6 months, the right to vote was granted to certain women; the first national conference on nursing was held, and the Jordanian Nurses' Association was formed. In Damascus, the school of nursing in the university is moving ahead steadily,

The baby helps train Greek student nurses to become "substitute mothers."

with Syrian nurses in the key positions. And in Egypt, a school of nursing has been established in the University of Alexandria.

The countries in the Far East are also moving ahead in the development of nursing. Taiwan has started a university school. Japan is pushing vigorously ahead. India is leading the way in many respects. And the gentle Vietnamese, in whose country nursing education was nothing more than an apprenticeship a few years ago, are increasing their 2-year course to 3 years, and Vietnamese nurses are directors of two branches of the National School of Nursing located in Saigon and Hue.

Developing Professional Role

If we consider regions rather than individual countries, we can certainly say that Latin America has advanced more rapidly than any other region of the world. Last year, the Brazilian nurses realized that they knew too little about their professional situation and felt that nursing was at a stage of development where they must decide which road it would follow. So the Brazilian Nurses' Association undertook a survey of the nursing resources of the entire country. This important survey will be completed in June 1958. Considerable useful and revealing data have come from this survey already. Other countries are beginning to look at their own nursing resources more carefully as a result of the Brazilian study.

Another significant mark of progress in Latin America is the thorough scrutiny of curriculums which is now going on in many schools of nursing. Formerly, the better schools quite clearly reflected British or American patterns and influences. But in recent years the conviction is growing that these are not good enough because they do not prepare the nurses adequately for the health problems peculiar to their own areas. As an example, courses in teaching and supervision are being introduced in the third year

Giving typhoid immunizations is part of this student's course in public health nursing at American University of Beirut, Lebanon.

because the graduates, however young and inexperienced, are called on to assume positions of responsibility in teaching and supervision. This situation will probably remain unchanged for some time to come.

In many countries, midwifery, including maternal and child health, and basic nursing are still separate professions. This concept is now changing with the recognition of the importance of midwifery and maternal and child care as a part of the education of the nurse.

Another significant improvement is reflected in the marked increase in the number of articles on nursing written by Latin American nurses, and in their growing interest in the writing of nursing textbooks. Such textbooks, made available in Spanish for all nurses, will release them from dependence on translations of English and American textbooks, which may or may not apply to their situations.

The nursing profession is becoming interested and actively engaged in various aspects of research. Last year, the Florence Nightingale International Foundation held a 2-week seminar on research at Sévre, France, the first of its kind. Representatives of 20 countries participated, each reporting on some special study going on in her own land.

The International Labor Organization, a specialized agency of the United Nations, has undertaken a worldwide study of the employment and working conditions of nurses. The ILO states that the objective of the study is "to obtain the fullest possible information on the social and economic status of nurses throughout the world."

Lest I mistakenly leave you with the impression that nurses alone have brought about all these changes, I shall mention a few other forces and factors that have played an important role. Among these are the spread of the emancipation of women, the expanded educational opportunities for girls, the number of girls receiving advanced schooling, the creation of new nations with their developing health services, the tremendous cultural and sociological changes in some areas of the world, the great ease of communication which facilitates the exchange of ideas, the dramatic technical and scientific advances, and the pressures brought to bear by the masses for improved health services. In this complex and changing world, particularly in the East, women today in different degrees are playing a vital part, no longer content to be merely bystanders and recipients of the benefits of change, but demanding that they be allowed to work creatively in their own environment to help form a new society.

Perinatal Mortality Conference

If avoidable perinatal mortality is to be reduced, a new philosophy and a new approach to the education of doctors, nurses, and patients are needed. This was the consensus of a conference followup of the New York Academy of Medicine's 1955 study of mortality among infants from the 20th week of gestation through the 6th day after birth.

The conference at the Academy on October 29, 1957, was sponsored by official and voluntary agencies and representatives of the medical profession. Specialists in obstetrics, pathology, anesthesiology, nursing, hospital administration, social work, preventive medicine, and public health education participated.

Group discussions of questions raised by the study of 955 perinatal deaths in New York City led to recommendations for improving maternity care and reducing infant deaths.

Prematurity, the cause of two-thirds of perinatal mortality, could be lowered by strengthening prenatal care; prescribing nutritional supplements according to the mother's needs, just as medication is prescribed; doing more social case work among expectant mothers; avoiding meddlesome obstetrics and elective inductions of labor; and prohibiting active physical work for women with small heart volume and low hemoglobin. The conferees also pointed out that prematurity is expensive; in a municipal hospital the care of a premature baby costs $360, a full-term infant, $100.

The specialists listed what hospitals and maternity clinics can do to reduce perinatal mortality.

They recommended that hospitals should emphasize the needs of people as much as the acquisition of skills in teaching interns and house physicians; provide 24-hour supervision with the supervisors aware of the background of each patient in labor; encourage mothers, once they return home, to telephone for advice; assign a staff member to answer their calls; and discuss current perinatal mortality regularly at staff meetings.

They also said that hospital maternity clinics should be encouraged to use more social workers and nurses trained in midwifery; set up appointments to reduce patients' waiting time, and use waiting time in the clinic for prenatal education.

The conferees further suggested that information about childbearing be made part of every young person's education and urged more research in habitual abortion, endocrine imbalance, physiology of the uterus, and physiology and function of the placenta.

Afghanistan charts health goals

GLENN S. USHER, M.D., M.P.H.

Afghanistan is a newly emerging nation of the free world which in recent years has accelerated the development of its resources. The government recognizes that its greatest resource is its people, and is striving to improve their health and well being.

In the spring of 1957 the Minister of Health of Afghanistan requested the International Cooperation Administration to provide consultation relative to the expansion of the country's health program with ICA's assistance. Accordingly, at ICA's request I visited Afghanistan in July and August of that year.

FROM KARACHI, Pakistan, to Kandahar, Afghanistan, the plane flies over a vast expanse of eroded hills almost devoid of human habitation. Then suddenly an oasis of irrigated fields appears below. This is Kandahar, the first stop in Afghanistan.

Kandahar gives the impression of being a city of unfinished buildings. One drives through long rows of them in various stages of construction, mute evidence of plans afoot to make Kandahar a major air terminus.

In the hospitals also there is an air of anticipated change. There are 2, 1 for men and 1 for women. While a new women's hospital is being constructed, female patients occupy the residence of a king who ruled 100 years ago. As it is a relatively new thing here for women to seek hospitalization, only a few beds for inpatients are provided in this temporary facility.

For the present, the health services of Afghanistan emphasize preventive medicine and maternal and child health activities. With the help of a physician and two nurses provided by the World Health Organization (only the two nurses remain), the Afghan provincial medical officer and his staff have organized prenatal and postnatal clinics, pediatric and well-baby clinics, mothers' demonstration classes, a domiciliary midwifery program, and

Dr. Usher is special assistant for medical activities, Communicable Disease Center, Public Health Service. At the time this paper was written, he was chief of the Program Development Branch of the Division of International Health, Public Health Service. Some of the background information for the article was compiled by Jane H. Priest, analyst in the Program Development Branch.

training courses for midwife aides. It is a well-conceived program which is gradually expanding to serve the needs of the people and to become a training center for the area.

The men's hospital is a 60-bed facility for which the provincial health officer is gradually acquiring improved equipment. Some of the new equipment has been acquired from the United Nations Children's Fund. In the outpatient department, emphasis is placed on preventive medicine, particularly venereal disease control.

Venereal disease rates of prevalence have been comparatively low in Afghanistan. Nevertheless a program to control these diseases was one of the first modern public health activities to be undertaken by the government. In Kandahar it is under the direction of an Afghan physician who received training at Johns Hopkins University under a WHO fellowship. Treatment schedules are modern, utilizing penicillin procaine with aluminum monostearate, and the control program includes case-holding activities, mass blood testing, contact tracing, and education.

Associated with the two hospitals in Kandahar is a well-equipped X-ray institute under the direction of an alert, energetic doctor. It contains equipment also for taking electrocardiograms and measuring basal metabolism.

To Kabul

From Kandahar to Kabul (pronunciation rhymes with gobble), we flew over valleys between rugged mountains. In the valleys are occasional patches of irrigated fields and a few towns. One of the towns is Ghazni, which many centuries ago was the cultural center of this part of the world. We also saw evidence of many of the underground channels which in Afghanistan are called *karez* and in Iran, *ghanats*. From the air, they look like rows of doughnuts. Each "doughnut" represents a place where the dirt from the underground channel has been brought to the surface. The *karez* are the means by which ground water from the bases of the hills and mountains is channeled with a minimum of evaporation to the fields and villages where it is used.

After the bumpy trip over the mountains, we arrived in Kabul, which is another city undergoing the process of modernization. The most obvious evidence of this is the streets, which a few years ago were bumpy and rutted and which now the government, with Russian assistance, is paving.

Here, as in Kandahar, the air of change is reflected in the medical and public health institutions and facilities. Under the guidance of a Minister of Health who obtained his medical and public health education in American schools, and with the assistance of WHO and UNICEF, the government is emphasizing solution of the basic problems of sanitation, hygiene, and preventive medicine.

The People

The inhabitants of Afghanistan are a mixture of people of Mongolian, Aryan, and Semitic origins. The so-called "true" Afghans speak Pashto (pronounced pushtoo). The men of this group are usually tall and broad shouldered with straight noses, regular features, and rather dark complexions, although some are fair, claiming descent from the Greek legions of Alexander and the ancient tribes of Israel. The group belongs to the Pathan tribes and is dominant ethnically. One of these, the Durani tribe, numbering less than 1¼ million people, has been the ruling faction for the last 200 years.

In a broad band along the Russian border and the Oxus River are the Turkomans of Mongolotartar origin, differing from the rest of the population by their Turkish dialect, dress, and the shape of the tents used by their nomadic members. They are herdsmen and breeders of karakul sheep. South of the Turkomans, in the center of the country, are found the Hazaris, of Mongolian origin, descendants of Genghis Khan's followers. They speak Persian and related dialects.

In a small pocket in the east central area are the Uzbeks, a fair-skinned people with Mongoloid features belonging to the Turki-speaking tribes. Along the Iranian border are isolated groups of Tajeks, who are racially Persians but who resemble the "true" Afghans. They tend more to engage in industrial pursuits than do other Afghans, those living in towns forming

most of the Afghan middle and upper-middle class.

The nomadic herders, known as *Kochis*, or choochies, probably constitute about 25 percent of Afghanistan's population of 12 million. Many travel from their summer ranges along the Iranian border and the Hari River Valley to Pakistan for the cold months, often crossing the Khyber Pass at the rate of 10,000 a day at the height of the migration (*1–3*).

Living Conditions

Even in the cities the scarcity and high cost of lumber prohibits the use of wooden houses. Plastered mud brick, baked brick, and stone are the materials used. Many of the poorer homes have domed roofs to avoid the necessity of using wood to support a flat roof. The flat roofs are covered with sun-dried mud which sheds water quite well in a heavy rain but which in a slow rain or sleet often leaks. The better homes in the cities are rather well constructed and have tile floors, but the poorer homes usually have floors which are not impervious to water.

There is much overcrowding with consequent hazard of transmission of communicable diseases. Furthermore, in the kitchens one seldom finds the sinks, tables, and utensils which would facilitate the sanitary handling of food (*1*).

Water Supplies and Sanitation

Kabul and some of the larger towns have water supplies with community taps. The government is taking steps to improve these supplies and make them safer. In fact, the city of Kabul is drawing up plans for a modern water supply system. In most of Afghanistan not only agriculture but the gardens and trees in the cities and villages depend upon irrigation. The irrigation ditches are subject to pollution from many sources, and it is from these that some of the people derive their water supplies for domestic use. Also, vendors use this water to freshen their vegetables. (Another great hazard to the sanitary quality of vegetables is the use of night soil as fertilizer.)

In many of the small towns and rural areas, well water is used. The Ministry of Health is planning a large well-drilling program to increase the availability of this source of supply and is preparing sanitarians to supervise construction and to teach sanitary maintenance of the wells.

These sanitarians will also be utilized to help improve general conditions of sanitation and hygiene, and it is expected that their effectiveness will be augmented by an aggressive health education program which the Ministry is planning.

Health Conditions

The Ministry of Health has established a health statistics section and, with the help of the World Health Organization, is taking steps to improve the collection and analysis of statistics. As things stand now, however, there is very little factual material on which to base estimates as to length of life or the prevalence of disease. Estimates of life expectancy in Afghanistan range from 20 to 40 years.

Malaria, tuberculosis, intestinal diseases, and poor nutrition are said to be the principal preventable health problems, but a nationwide malaria control program, assisted by WHO and UNICEF, is rapidly bringing malaria under control. Typhoid and paratyphoid fever and the dysenteries are endemic with epidemic outbreaks. Until recently, typhus fever epidemics occurred regularly, but now they have largely been brought under control. In 1956 there was not a single confirmed case of typhus fever in the country. Infestation with parasites is almost universal in children, and diarrheal diseases are extremely common. Trachoma and other eye disorders are prevalent, at least in some areas. The prevalence of venereal diseases, on the other hand, appears to be relatively low. Any estimate of the infant mortality rate would be little better than a guess, but it is undoubtedly well over 100 per 1,000 live births (*1, 3–5*).

Medical Care Facilities

Most medical institutions in this country are supported by the government, and treatment is provided free. There are 35 hospitals, 5 in

Kabul, 15 provincial, and 15 small district hospitals, with a total capacity of some 1,400 beds (*1*). Separate hospitals are maintained for men and for women. Under the government's 5-year plan, funds have been allocated with which to build additional hospitals and to provide better facilities and modern equipment for the existing ones. In this building program, emphasis will be placed on providing more hospital beds for women in order to bring their facilities up to a par with those for men.

Only 249 physicians have been graduated from the Faculty of Medicine since its founding in 1932. Probably not many more than 200 are practicing at the present time, and there are about 15 or 20 foreign physicians in the country.

A limiting factor in relation to medical education, as well as all other forms of higher education in Afghanistan, is the small number of students who are graduating each year from the secondary schools. However, the number is increasing year by year, and in addition just this past year the government has decided to allocate a larger number of them to the Faculty of Medicine. Whereas in recent years the number of admissions to the study of medicine has been about 35 or 40, it was expected at the time of this visit that about 100 would be admitted this year. This poses a serious problem to the Faculty in providing the facilities and instructors to teach that number of students. In its 5-year plan the government has allocated substantial sums of money to provide the facilities and to upgrade the teaching hospitals.

The training of nurses is also the responsibility of the Faculty of Medicine, and in this area too it is faced with a serious problem. Up to the present time few nurses have been trained. They are mostly male nurses. The Faculty has asked WHO for help, and a 5-year plan has been developed which calls for a rapid expansion in nurse training.

The training of midwives, on the other hand, is under the jurisdiction of the Ministry of Health. For this purpose it uses the recently upgraded maternity hospital in Kabul. Assistance in providing better equipment was given by UNICEF, and services were greatly improved with the assistance of WHO personnel, especially by Dr. Gade, a Danish woman physician who won the hearts of the Afghan personnel with whom she worked. She established the midwifery school in a large building constructed on the grounds by the government. The school is now under the direction of a princess of the royal family.

Public Health Activities

In addition to bringing typhus fever under control, the government is making good progress in eradicating malaria and in establishing maternal and child health facilities. A start has been made on tuberculosis and venereal disease control and in the improvement of sanitation in a few limited areas of the country.

The Faculty of Medicine is expanding its training program for both male and female nurses, and the Ministry of Health is expanding its training programs in public health for physicians, public health nurses, midwives, sanitarians, laboratory personnel, and statistical personnel. The Ministry of Health, with the assistance of WHO, has recently established a school for sanitarians which is being expanded.

Public Health Institute

To develop and coordinate these various training activities the Ministry of Health is in the process of establishing an Institute of Public Health. In addition to the development and coordination of training activities the institute will administer the public health laboratory, the Ministry's health statistics activities, and a new health education department. It will establish a public health library, and it will conduct epidemiological and nutritional studies and surveys.

Out of these activities the Minister feels that there will be derived the means for more effective evaluation of public health programs and for the intelligent establishment of program priorities realistically related to disease prevalence, the socioeconomic condition of the people, and the available resources. It is an ambitious undertaking for a country in the early stages of its economic development but one which should make a substantial contribution to the effective execution of the country's public health programs.

The Helmund Valley

To go from Kabul to Lashkar Gah, we flew back to Kandahar and then traveled 90 miles west over a gravel road, one of the best in Afghanistan. Both Kandahar and Lashkar Gah are in an area which in recent geologic time was probably part of a vast lake without an outlet. The area still has no outlet for the streams and rivers which flow into and through it. They flow into a great salty depression in the southwest portion of the area and there the water which does not sink into the ground evaporates.

Lashkar Gah, a new city located on the Helmund River, is the headquarters of a large irrigation and land development project administered by the Helmund Valley Authority, which is similar in some respects to the Tennessee Valley Authority. The project is being used for the settlement of large numbers of people from the nomadic tribes.

Lashkar Gah is being built for the specific purpose of providing headquarters for HVA and for the government of Girishk Province. It is expected that the provincial government will be moved there soon. The city derives its name from a city which was once a flourishing military cantonment in an ancient Afghan empire, but which is marked today only by hulking ruins nearby. In the neighborhood are also ruins of a castle which was 8 stories high and covered some 2 or 3 acres of ground.

The city is being built according to plan, with well laid-out streets, well designed and constructed houses, a good water supply, and a sewage-disposal system. The foundations are being laid for a 30-bed demonstration health center and training school for health personnel, which will be modern in design and equipment. With the assistance of the International Cooperation Administration, the health center will be the central facility for a network of subsidiary health centers in Girishk Province, which forms the major part of the area under the jurisdiction of HVA. It is planned that from these health centers not only the new settlers but the old inhabitants of the area also will receive the benefits of modern medicine and public health and the present-day teachings of hygiene and sanitation (*2, 3*).

Summary

Substantial progress has been made in establishing the medical and public health institutions and organizations needed in Afghanistan. Training of essential personnel is necessarily slow because of the scarcity of people with the prerequisite educational qualifications, but this problem is being alleviated as the educational system expands.

Progress is being made also in combating some of the country's most serious preventable diseases, notably malaria and typhus fever, and in developing maternal and child health activities, but much remains to be done in the entire field of public health and sanitation. Implementation of the plans of the Ministry of Health for the development of its new Institute of Public Health should contribute materially to the improvement of health facilities and programs.

Another interesting development which is planned for the near future is the establishment of a public health program in the Helmund Valley which will provide health services for nomads who are being settled on newly irrigated land and will at the same time provide a demonstration of the application of public health methods and an area for the training of public health personnel.

REFERENCES

(*1*) Simmons, J. S., Whayne, T. F., Anderson, G. W., and Horack, H. M.: Global epidemiology, a geography of disease and sanitation. Philadelphia, J. B. Lippincott Co., 1954, pp. 163–177.

(*2*) Cervin, V.: Problems in the integration of the Afghan nation. Middle East Journal 6: 400–416, Autumn 1952.

(*3*) Lowe, C. U.: Observations on the care of children in Afghanistan. Pediatrics 15: 771–774, June 1955.

(*4*) United Nations: Report on the training center on vital and health statistics, Kabul, Afghanistan, 1954. Statistical papers Series M, No. 24. New York, N. Y., March 1955.

(*5*) World Health Organization: The work of WHO, 1954. Geneva, March 1955, pp. 74, 143–144.

International Population Movements as Aids to Communicable Disease Control

CLARENCE A. SMITH, M.D., JOHANNES STUART, Ph.D.,
and WILLIAM C. WATSON, Jr.

POPULATION movements have always been viewed as a real or potential hazard in the spread of communicable disease. In the Crusades, the internecine conflicts of the Renaissance, and the conquests which brought the Americas into the orbit of European culture, disease was always one of the horsemen riding side by side with the soldier, the merchant, and the priest. The traveler's course might be traced by the implantation of disease as well as by the growing weeds whose seeds had dropped from his saddlebags.

It is only in recent years, and even then with little real appreciation of its inherent logic and potential strength, that public health workers have taken advantage of population movements and used them as a positive force for health by combining a few simple ingredients of border inspection, quarantine, treatment, and control epidemiology.

While several rudimentary examples of this approach in regard to mobile populations have emerged from the operation of the venereal disease control program of the United States, no example existed prior to 1956 in which use was made of an international population movement that would apply all of the basic elements of venereal disease control for the benefit of two countries.

It was therefore a program of new stature which the national health agencies of Mexico and the United States undertook in 1956 when they decided to weld together the elements of a complete international control program and apply it to Mexican migrant laborers coming into the United States during the growing and harvesting season.

It should be clearly understood that such synthesis cannot be affected at will. It is based on mutual respect and understanding between the two nations as well as upon a number of preconditions, including facility and speed in diagnosis and treatment, the existence of a contact-eliciting and contact-tracing mechanism, and the availability of forces which can be mobilized to accomplish diagnosis, treatment, and contact investigation. Even in 1956 when jet planes hurtled through the air at speeds far exceeding sound and the mysteries of orbital space had become the commonplace of newspaper headlines, these factors were not entirely adequate to cope with all aspects of the combined programs; they were present in sufficient degree, nevertheless, to merit the sizable demonstration test which we describe.

More than 400,000 Mexican agricultural workers enter the United States each year to work in our fields at the times when there is an urgent seasonal demand for labor. Physical examinations are given these workers by the Public Health Service Division of Foreign Quarantine, both at the recruitment centers in

The authors are all with the Public Health Service. Dr. Smith serves as deputy chief of the Communicable Disease Center, Dr. Stuart, public health advisor in the Office of the Surgeon General, and Mr. Watson, public health advisor in the Venereal Disease Branch of the Center. *By special arrangement, the article appears simultaneously, in substantially the same form, in the Boletín de la Oficina Sanitaria Panamericana.*

Mexico and the reception centers on the American side of the border. These examinations serve to detect most of the clinically evident venereal disease. However, in the absence of a blood-testing program, syphilitic workers without clinical symptoms at the time of admission have gone undetected. Mexican and United States health workers have repeatedly explored means of using the opportunity presented by these population movements to develop a syphilis control program benefiting both countries.

Mass Blood Testing Begun

Because of difficulties of organization and finance, no substantial combined activities were undertaken until 1956, when it was informally arranged between the two Federal health agencies that as many of the migrants as possible would be blood tested in Mexico and that the Public Health Service would assign syphilis control teams to at least some of the five reception centers through which Mexican agricultural workers pass to be processed and assigned to the growers who use their services.

The United States testing teams reported that an occasional worker volunteered evidence of a recent serologic test for syphilis. It was, however, impossible for these teams, handling a high volume of workers with whom they had communication difficulties, to determine how many had been blood tested in Mexico. It is the activities of the United States teams that we report in the following paragraphs.

Table 1. Mexican border testing program, 1956: number tested and number and percent reactive, by Mexican state of origin

Mexican state	El Centro			El Paso			Total		
	Number tested	Number reactive	Percent reactive	Number tested	Number reactive	Percent reactive	Number tested	Number reactive	Percent reactive
Aguascalientes	247	9	3.6	146	14	9.6	393	23	5.9
Baja California	1,516	198	13.1	1	0	0	1,517	198	13.1
Baja California Sur (territory)	1	0	0	0			1	0	0
Campeche	0			0			0		
Chiapas	4	0	0	0			4	0	0
Chihuahua	20	1	5.0	22,502	1,464	6.5	22,522	1,465	6.5
Coahuila	17	4	23.5	1,606	213	13.3	1,623	217	13.4
Colima	408	37	9.1	5	0	0	413	37	9.0
Distrito Federal	599	87	14.5	222	30	13.5	821	117	14.3
Durango	3,162	256	8.1	10,619	845	8.0	13,781	1,101	8.0
Guanajuato	12,635	843	6.7	825	38	4.6	13,460	881	6.5
Guerrero	3,968	752	19.0	408	52	12.7	4,376	804	18.4
Hidalgo	241	20	8.3	51	3	5.9	292	23	7.9
Jalisco	13,469	1,369	10.2	4,225	423	10.0	17,694	1,792	10.1
Mexico	2,161	140	6.5	1,364	65	4.8	3,525	205	5.8
Michoacan	10,605	763	7.2	913	49	5.4	11,518	812	7.0
Morelos	652	68	10.4	126	13	10.3	778	81	10.4
Nayarit	517	69	13.3	2	0	0	519	69	13.3
Nuevo Leon	3	0	0	8	1	12.5	11	1	9.1
Oaxaca	3,557	266	7.5	466	32	6.9	4,023	298	7.4
Puebla	1,168	61	5.2	527	25	4.7	1,695	86	5.1
Queretaro	171	14	8.2	402	19	4.7	573	33	5.8
Quintana Roo	0			0			0		
San Luis Potosi	816	44	5.4	61	1	1.6	877	45	5.1
Sinaloa	409	28	6.8	0			409	28	6.8
Sonora	273	29	10.6	1	0	0	274	29	10.6
Tabasco	190	24	12.6	2	0	0	192	24	12.5
Tamaulipas	18	4	22.2	29	5	17.2	47	9	19.1
Tlaxcala	321	20	6.2	278	26	9.4	599	46	7.7
Veracruz	179	14	7.8	57	7	12.3	236	21	8.9
Yucatan	129	13	10.1	8	0	0	137	13	9.5
Zacatecas	5,637	304	5.4	6,968	419	6.0	12,605	723	5.7
Unknown	546	54	9.9	45	5	11.1	591	59	10.0
Total	63,639	5,491	8.6	51,867	3,749	7.2	115,506	9,240	8.0

Pursuant to our agreement, and in cooperation with the U. S. Department of Labor, two of the reception centers—El Paso, Tex., and El Centro, Calif.—were chosen for the assignment of such teams over the period August 16 to October 12, 1956. This period covers the great fall harvesting season when the migrant movement swells to a peak. During that period 115,506 Mexican workers were blood tested; 9,240 were found reactive to a serologic test for syphilis; 7,098 were given treatment in the United States; 1,532 notifications were sent to Mexican health departments on workers not found prior to their return to Mexico; and 7,004 marital contact reports on the wives of workers with a positive test for syphilis were sent to Mexican health departments. All in all, then, the control aspect of this program concerned itself with 16,244 syphilis suspects, comprising the 9,240 men who were positive reactors and the 7,004 women who were married to positive reactors.

Who were these people, and what happened to them? Table 1 and the chart show the distribution of the male workers and states from which they came. Almost 80 percent of all the migrants tested at El Centro and El Paso came from the six states of Chihuahua, Durango, Guanajuato, Jalisco, Michoacan, and Zacatecas, but the rate of positivity for this group was somewhat lower than average. Certain other areas with a lesser flow of migrants, such as Baja California (Norte), Distrito Federal, Guerrero, and Nayarit, contributed markedly higher than average rates of positivity. Although these states vary widely in the known prevalence of pinta, no attempt was made to evaluate the role which each of these diseases played in the total numbers of serologically positive tests.

Marquez, Rein, and Arias, in reporting findings of the study of pinta in Mexico carried out by the Mexican Ministry of Health during 1929–31, indicate that those states affected were Guerrero, Oaxaca, Mexico, Chiapas, Michoacan, Puebla, Tabasco, Morelos, Nayarit, Veracruz, and the highest prevalence was found in Guerrero where approximately 20 percent of the population is affected.

The Mexican Ministry of Health had requested us to prepare the tabulations given in table 1 since this would give them a helpful cross section analysis of treponematosis in the areas from which migration came. The data do not, of course, reflect internal variations within the states concerned but, since the majority of the contract workers were rural and since the migratory populations have other identifying characteristics, the information contained in the table should be of considerable use to control programs in the areas concerned. The table provides a current index to the extent of the problem among the group tested.

But, however important it may be to define the extent of a problem, it is much more important to do something about it. Herein lay a great difficulty. We knew that the stay of the Mexican workers in the reception centers was usually for only a few hours. It was something of a problem even to collect a blood specimen on all comers during those few hours because the centers were set up to process as many as 4,000 men per day, and our teams experienced a number of days when the flow was well over 3,000. Even writing a laboratory report form on each man was out of the question, especially since most of our team members did not speak Spanish. So we decided to microfilm the workers' Labor Department identification forms, an important factor in the control operation because it also contained the name, re-

Table 2. Disposition of 9,240 Mexican agricultural workers with positive serologic tests for syphilis, by State to which cases were referred

State	Number of workers referred	Treated for syphilis		Not located
		Number	Percent	
Arizona	38	10	26. 3	28
California	5, 468	4, 215	77. 1	1, 253
Colorado	30	30	100. 0	0
Kansas	6	6	100. 0	0
New Mexico	899	780	86. 6	96
Texas	2, 325	2, 057	88. 5	268
Not referred to a State [1]	474	0	0	474
Total	9, 240	7, 098	76. 8	2, 119

[1] Of those not located or not referred to a State, 1,532 were reported to the Mexican Ministry of Health for action upon their repatriation. The remainder were not reported to Mexico for lack of complete address.

Percentage of positive reactors to serologic tests for syphilis among 115,506 Mexican contract laborers, by state of residence in Mexico, 1956.

lationship, and address of his nearest-of-kin, usually his wife.

On this Labor Department form we stamped the number of the worker's blood tube. Then, after the name and address of the grower to whom he had been assigned was entered on the form, we microfilmed the entire document. We therefore had in our possession on one document a complete record of where we could locate both the man and his wife—a document obtained at a cost of seconds per person tested.

Case Finding Expedited

We knew that finding these workers after they had left the reception centers would not be easy. Back in 1951 we had experienced bitter failure in our first attempt to do this. In that year we tested some 11,000 Mexican braceros, sent their blood specimens to the Public Health Service Venereal Disease Research Laboratory in Atlanta, and the positive reports to the State health department concerned. Because of the time lapse involved, most of the persons with positive blood were never found: they had moved from the farm of their original assignment.

This time we were prepared to deal more expeditiously with the laboratory phase of the program. With the active and energetic cooperation of the State health department laboratories of Arizona and Texas, serologic reports reached the reception center within 24 hours after blood specimens were taken. Blood was flown from the center to the laboratory in the afternoon, analyzed the following morning, and reports returned to the center on the same day. Suspect reports prepared by the center on all individuals with a seropositive test for syphilis might therefore reach the destination of the bracero very shortly after his arrival on the farm of his first work assignment.

In the States of the Pacific Coast we had a strong case-finding ally in the Continental Casualty Company, the insurance firm which provides medical care for braceros on the west coast. They voluntarily proposed that their officials in California arrange, with the aid of the growers' association and farmers, to locate each serologically positive Mexican worker and bring him in to the office of their local physician for diagnosis and treatment. We accepted this offer with great alacrity, although we assured the company that their task would not be an easy one.

Nor was it accomplished without some substantial difficulties. Some few growers' associations at the peak of their seasonal work were at first apathetic or even hostile. Some physicians found themselves so burdened with the other medical problems of braceros that they could not give effective service to the syphilis suspects, so that the Public Health Service had to send in help. But the great bulk of seropositive men were finally found and treated.

In the other States—chiefly Texas, New Mexico, and Arizona—case finding was done by regularly employed investigators working in the State venereal disease program. They were focused on the areas receiving braceros for the period of need. In New Mexico and Arizona, public clinics provided diagnosis and treatment. In Texas, medical service was obtained in large part by contract with private physicians.

Seventy-seven percent of the serologic re-

Table 3. Disposition of 7,004 marital contacts of seropositive Mexican workers reported for investigation in Mexico

State	Number referrals sent	Number returned	Brought to treatment	Returned to treatment	Already under treatment	Adequate treatment	Located but uncooperative	Not infected	Cannot locate	Insufficient information	Moved	Other
Aguascalientes	16	7	1	0	0	0	0	5	0	1	0	0
Baja California	155	104	5	0		1	20	26	28	19	5	0
Baja California Sur (territory)	2	2	0	0							2	0
Campeche	0											
Chiapas	0											
Chihuahua	996	53	6	0	0	3	1	23	20	0	0	0
Coahuila	149	20	1	0	0	1	1	7	0	0	10	0
Colima	25	20	3	0	2	0	0	14	0	0	0	1
Distrito Federal	82	0										
Durango	804	0										
Guanajuato	754	115	8	0	0	0	3	68	28	0	4	4
Guerrero	583	0										
Hidalgo	17	15	0	0	0	0	0	0	6	4	5	0
Jalisco	1,400	0										
Mexico	151	49	7	0	2	1	0	17	16	5	1	0
Michoacan	671	42	1	2	1	0	6	32	0	0	0	0
Morelos	48	10	10									
Nayarit	49	5	2	0	0	0	0	1	2	0	0	0
Nuevo Leon	0											
Oaxaca	212	0										
Puebla	67	0										
Queretaro	14	7	1	0	0	0	0	6	0	0	0	0
Quintana Roo	0											
San Luis Potosi	39	0										
Sinaloa	12	9	0	0	0	0	1	5	2	0	1	0
Sonora	26	8	0	0	0	0	0	0	8	0	0	0
Tabasco	18	0										
Tamaulipas	9	1	0	0	0	0	0	0	1	0	0	0
Tlaxcala	33	0										
Veracruz	10	1	0	0	0	0	0	1	0	0	0	0
Yucatan	7	6	0	0	0	0	1	5	0	0	0	0
Zacatecas	600	0										
Unknown	55	0										
Total	7,004	474	45	2	5	6	33	210	111	29	28	5

actors were treated (table 2). Of the 2,119 not located, suspect report forms were sent on 1,532, after the crop season was over. Information on the suspect was transmitted on the recently instituted multilingual form developed by the Pan American Sanitary Bureau and now available for use by all nations of the Americas in the international reporting of venereal disease contacts and suspects. This form, sent to the Mexican state health department of jurisdiction, advised in Spanish that the person named had been tested in the United States, that the result of this test was positive, and that he had returned to Mexico before diagnosis could be made and treatment instituted.

This completed our work on the 9,240 braceros whose blood tests were positive. Its overall efficiency was 77 percent, even without accounting for the men who might subsequently have been located in Mexico. This is a pretty fair degree of case-finding efficiency for any group of syphilis suspects, but is phenomenal in relation to so highly mobile a foreign language group.

As has been indicated earlier, we reported to Mexico a total of 7,004 women who were marital partners of braceros with a positive test for syphilis. The reports on these wives were also sent on the Pan American Sanitary Bureau form. Each of these, too, carried an individual communication in Spanish advising the recipient health department that the person named in the form was a familial contact of a seriologically positive Mexican worker currently in the United States. It further requested that the Public Health Service be notified as to the results of investigation.

Relatively few replies were received indicating what action had been taken (table 3). This is not particularly surprising. In the first place, our experience in the United States indicates that there is a curious reluctance on the part of several State health departments to report a disposition on a contact report received from out of State. Since reporting to another country involves the mental bridging of an even larger gap, we can readily appreciate how much good case finding may have been accomplished through the use of these forms without our obtaining disposition reports.

We were also aware that a number of the addresses of wives which we used were incorrect or insufficient. Even though these addresses may be of great importance to the workers in the case of illness or death; poor communications, poor understanding, and possibly other factors work against their accuracy.

Table 4. Costs of blood testing, followup and treatment, and contact investigation of 115,506 Mexican agricultural laborers and their marital contacts

Activity	Total	Unit cost	
		El Paso	El Centro
Blood testing [1]	$0.564	$0.597	$0.537
Personnel	.241	.268	.220
Salaries	.147	.168	.130
Travel	.018	.017	.019
Per diem	.076	.084	.070
Laboratory	.223	.231	.215
Other	.099	.098	.102
Followup and treatment [2 3]	3.393	6.243	1.442
Salaries			.516
Travel			.120
Per diem			.232
Drugs			.574
Contact investigation:			
Per report sent	.194		
Per report returned	2.865		
Per case brought to treatment	23.414		

[1] Per person tested.
[2] Per person treated.
[3] Itemization of followup and treatment costs not available for El Paso.

Finally, the Pan American Sanitary Bureau form and the contact investigation procedure is relatively new to many Mexican health departments, particularly those of the rural areas from which most of the braceros come.

In spite of the low rate of return on disposition, it is of interest that almost a fifth of the cases reported as having been examined were brought or returned to treatment, indicating the relatively rich epidemiological vein which this reporting method makes available. If 17.5 percent of all the wife suspects were in need of treatment, the information contained in the 7,004 suspect reports might have led to the treatment of some 1,250 women with syphilis in Mexico.

Many desirable public health programs are relatively or absolutely impractical because of

their cost. Venereal disease control programs in the United States, as one aspect of their effectiveness, have always been mounted on the firm base of economical operation. This program was no exception, as can be seen from table 4. Total cost of blood testing was held to less than 60 cents per person, followup and treatment to an average cost of $3.39 per person, and the unit cost per suspect to 19 cents per report sent.

Conclusions

This program demonstrates several novel combinations: the utilization of a quarantine procedure as a basis for a full-scale venereal disease case-finding, treatment, and contact investigation program, as well as for depiction of the geographic distribution of another country's problem; the practical elimination of distance in laboratory functioning; the use of microfilm as a technique for venereal disease control; and the backing of an insurance company in health control operations.

Attention to operational novelties, however, emphasizes process over concept: the concept that the quarantine procedure shares with other testing devices the powerful potential of a case-finding tool.

Quarantine will continue to maintain the devices which protect against the hazards of disease importation. But it also may become—possibly for chronic as well as communicable disease—one of the screening devices which in the future will share with other health services the responsibility and the reward for alerting the individual and the community—the community of nations included—to the presence of disease and the needs and methods for its control.

REFERENCE

(*1*) Marquez, F., Rein, C. R., and Arias, O.: Mal del pinto in Mexico. Bull. World Health Org. 13: 299–322 (1955).

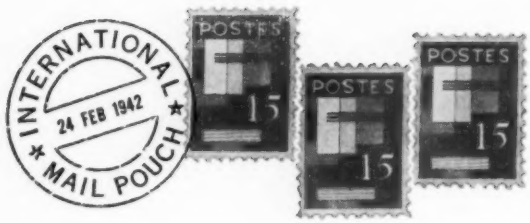
NIH Board of Scientific Counselors

A panel of six non-Federal scientists has been selected to comprise the Board of Scientific Counselors, established in February 1958 by the Public Health Service to review, discuss, and make recommendations on research in laboratories of the National Institute of Neurological Diseases and Blindness. The board held its first meeting in Bethesda, Md., February 20 and 21, 1958.

Chairman of the board is Dr. Hallowell Davis, director of research at the Central Institute of the Deaf, St. Louis. He will serve 4 years.

Appointed for 3-year terms are Dr. Howard J. Curtis, chairman, biological division, Brookhaven Laboratory, Upton, N. Y., and Dr. A. Earl Walker, professor of neurosurgery, the Johns Hopkins University.

The 2-year term members are Dr. Raymond Adams, chief of neurological services, Massachusetts General Hospital, Boston; Dr. Algernon B. Reese, clinical professor of ophthalmology, Columbia University College of Physicians and Surgeons; and Dr. Roger J. Rossiter, head of the department of biochemistry, University of Western Ontario, London, Canada.



This is the Way We Brush—

Toothbrushes were given 70 students in the small, 4-room school in Espilola, near Babol, Iran, with instruction in oral hygiene. The school, completed last year with point 4 assistance and staffed by two young, enthusiastic teachers, is the first program demonstration of school health in the Caspian region.

The children have been weighed and measured and tested for hearing and vision. The doctor of the Babol Health Center gave them physical examinations. We hope to make arrangements with private physicians and the Ministry of Health Hospital in Babol to correct the children's serious physical defects. The sanitation division is setting up handwashing facilities at the school.

—Glen W. McDonald, M.D., M.P.H., *chief, Public Health Division, U. S. Operations Mission, Iran.*

Bandit Attack

Ethiopian bandits attacked one of our drilling supervisors, Robert House, between Jigjiga and Dik. Shot in the back and twice in the face, he miraculously escaped death. He was evacuated from Jigjiga to Addis Ababa, to Asmara, Eritrea, to Bahrein in the Persian Gulf, to Germany, and finally to the United States, where he is recovering.

—A. C. Curtis, M.D., *chief, Health and Sanitation Division, U. S. Operations Mission, Ethiopia.*

Wan Phra Is Cleanup Day

Every "wan phra" is cleanup day in Panasnikom, Thailand. On the Buddhist weekly sabbath, the people clean their houses, the space underneath them, and their yards. The health committee roused interest in sanitation, and the resulting cleanup drive left the village spotless. Flowers and vegetables are planted in areas previously overgrown with weeds or cluttered with refuse.

Once Panasnikom's only source of drinking water during the dry season was a hole in the ground. The people walked down to the hole on rude planks and scooped up the muddy water at the bottom. Now they are building a water catch basin with shallow wells at two corners. International Cooperation Administration supplied pumps for the wells, which will be a year-round source of protected water.

The villagers themselves dug the wells and the catch basin, built the form for the well casings, and poured the casings and the slab. Sanitarians from Cholburi training center helped install the casings, slab, and pump.

—Robert L. Zobel, M.D., *chief, Public Health Division, U. S. Operations Mission, Thailand.*

Journey to Tobar Donoso

Anti-yaws campaign workers traveled for 8 days to reach the remote gold mining section of Tobar Donoso in northern Ecuador. Starting from the Colombian city of Tumace, they journeyed by railroad, boat, and pack animal into the Andes. All yaws cases and contacts in the isolated area were treated.

—James D. Caldwell, *chief, health, welfare and housing field party, U. S. Operations Mission, Ecuador.*

A Hut for the Zo

As a consequence of our classes in midwifery, the paramount chief in the small Liberian village we visited had built a hut where his wife, the head Zo, performs deliveries. In this and other villages the Gbarnga rural health unit holds classes for 135 midwives, or Zos. The classes concentrate on cleanliness, care of the umbilical cord, and recognition of abnormalities requiring medical attention.

In Sanniquellie we had a chance to compare our classes for midwives with the somewhat different system used by the hospital superintendent, a Liberian nurse who is English-trained. These Zos leave their families and villages and come to the Sanniquellie hospital for 14 or 15 months of experience. Except for housing, the midwives provide for all their own needs.

—Julia Worthington, *adviser, Public Health Nursing, U. S. Operations Mission, Liberia.*

Samples taken in 1955 indicate that most atmospheric particles likely to reach the lungs had a radioactivity of less than 5 μμc., but the radioactivity of single particles was as high as 500 μμc. The average concentration of beta activity was about 5 μμc. per cubic meter of air.

Radioactive Particles in the Atmosphere at Cincinnati, Ohio

R. LOUIS BRADSHAW, M.S.E.E., and LLOYD R. SETTER, Ph.D.

THE RADIOACTIVITY of air particles in samples collected in 20 to 30 municipalities in the National Air Sampling Network, established in 1953, indicated a thousandfold or more increase in beta radioactivity immediately following known tests of nuclear weapons. It was suspected that substantial amounts of the total radioactivity might be associated with discrete particles which might find their way into the respiratory tract of man. To determine the distribution of radioactivity in atmospheric particulate matter, a study was made of air samples collected at the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, during the winter and spring of 1955.

Sampling Apparatus

The particles in air samples were separated into primary and secondary fractions by a cyclone separator (*A*) in series with a filter (fig. 1). An air sampling rate of approximately 40 cubic feet per minute was selected, since at this flow the unit has an efficiency versus particle-size curve comparable to that of the upper respiratory system in man (*1, 2*).

A nosepiece on the intake of the cyclone separator provided a face velocity of 25 liters per minute per square centimeter, which approximates the nasal air velocity of a man at work. Particles passing through the separator were caught on the glass fiber filter. These, constituting the secondary fraction, are the particles that might penetrate to the alveoli in actual breathing. They were deposited on an effective filter area of 63 square inches.

Procedure

The sampler was placed on the roof terrace off the east side of the auditorium of the Sanitary Engineering Center, approximately three stories above the ground. The sampling rate was adjusted by a bleeder valve on the high-volume blower (capacity of 60–80 cubic feet per minute) to 40.5 cubic feet per minute at the beginning of each sampling period. The sampling rate at 24 hours was rarely more than 10 percent below the initial rate. The average of the initial and final rates was taken for flow calculation.

Two samples were collected February 16–18, 1955, before the first United States test of nuclear weapons that month. From February

Mr. Bradshaw, presently assigned to the Oak Ridge National Laboratory, Oak Ridge, Tenn., was formerly with the Robert A. Taft Sanitary Engineering Center of the Public Health Service, Cincinnati, Ohio. Dr. Setter is chemist in charge, radiological investigations, at the Center.

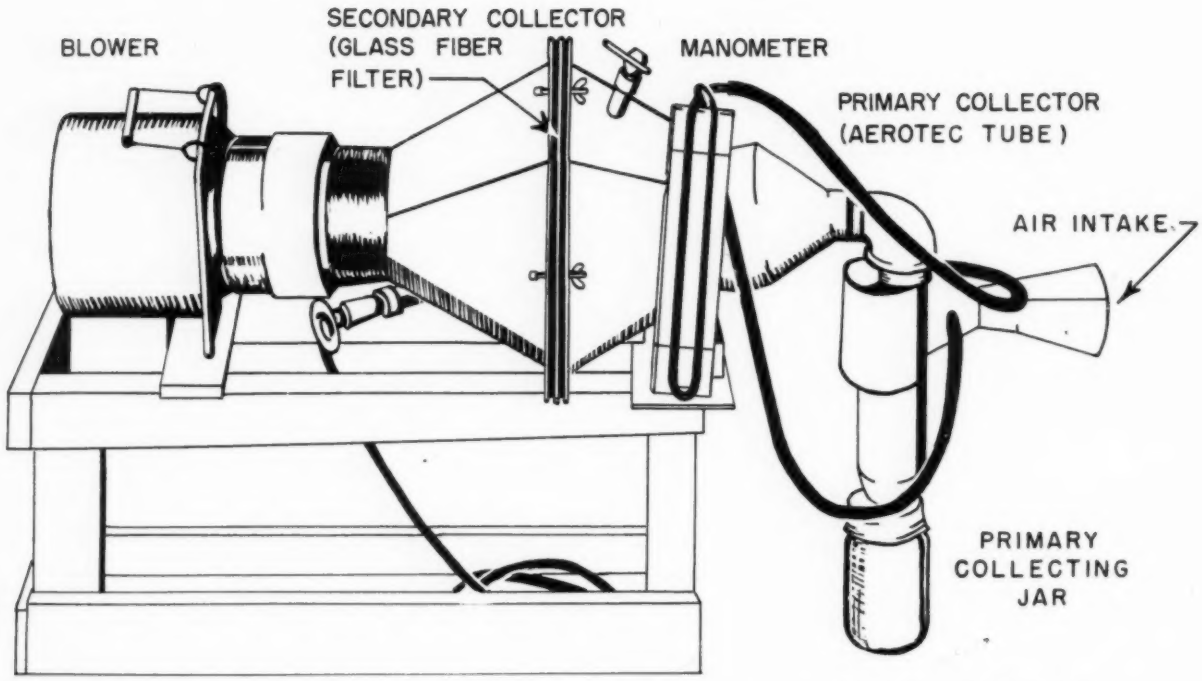


Figure 1. Air sampler used in Cincinnati study of atmospheric radioactivity, 1955.

19 through April 9 and again from May 5 through May 12, sampling was continuous except for changing filters and emptying the cyclone separator. Samples were collected daily (20–28 hours) except for one 3-hour sample, four 2-day samples, and one 3-day sample (indicated by the width of the bar graphs in fig. 2).

After each collection the dust in the cyclone separator was removed with 100 ml. each of distilled wash and rinse water. Ten percent (20 ml. of the combined wash and rinse water) was filtered through a cellulose acetate membrane filter (*B*) for counting and autoradiographing the samples collected through March 22 and the sample collected on April 3. The filtrate, containing the soluble activity from the primary fraction, was evaporated to dryness in an aluminum dish (2 inches in diameter) and similarly counted in an internal counter. Twenty-milliliter aliquots of the primary fraction of all other samples were evaporated in dishes without filtration and counted, but no autoradiographs were made. Repeat counts of some samples were made to establish radioactive decay rates.

For assay of the secondary fraction, a 1⅞-inch diameter circle (1/23 of the total filter area) was punched from the center of the glass fiber filter, counted in an internal proportional counter, and used for autoradiography.

The samples were held at least 4 and usually 16 or more hours after collection to permit decay of radon daughter activity ($T_{1/2}$=38 minutes) before the beta-gamma mixed fission product activity was counted in an internal gas-flow proportional counter having an efficiency of 50 percent (*3–5*). The measured activity of a sample was corrected for decay to the midpoint of the collection time from decay data or by the application of the exponential decay factor of −1.2 for fission-product activity formed on the most probable test date.

One to four days after collection, six membrane or glass-fiber filter samples were glued face up on a 5- x 7-inch sheet of paper. The sheet was then inverted on top of the emulsion of an X-ray film (*C*). A sponge rubber pad mounted on a 5- x 7-inch piece of plywood was placed on the inverted paper and weighted with a 16-lb. brick. The film was usually exposed for 20 to 28 hours before development for normal contrast with standard X-ray chemicals, according to the manufacturer's directions.

A calibration of the optical density developed on X-ray film from exposure to fission-product particles was made by using an isolated radioactive particle in the sample collected April 5, 1955. This particle of measured beta activity was used in a series of 8 exposures ranging from 5 minutes to 19 hours and in distance of particle to emulsion from 40 to 500 microns. The density (transmission) profile of a particle autoradiograph was determined with the aid of a microphotometer which viewed a film area 46 microns in diameter by means of magnification (1 : 10) and an aperture mask on the photocell.

Photometer readings were taken progressively from the center of the irradiated area outward until the density faded into background fog. From these readings the radiation exposures at the points of measurement were calculated (*6*) and used to equate the total radiation exposure received by the film. Since the radioactivity and length of exposure were known, a proportionality constant could then be calculated for each of the eight calibration exposures. The average of the eight proportionality constants was used to calculate the radioactivity of air particulates from their autoradiographs. The calculated activity of a radioactive particle was then extrapolated from decay data to the activity at the midpoint of the collection time.

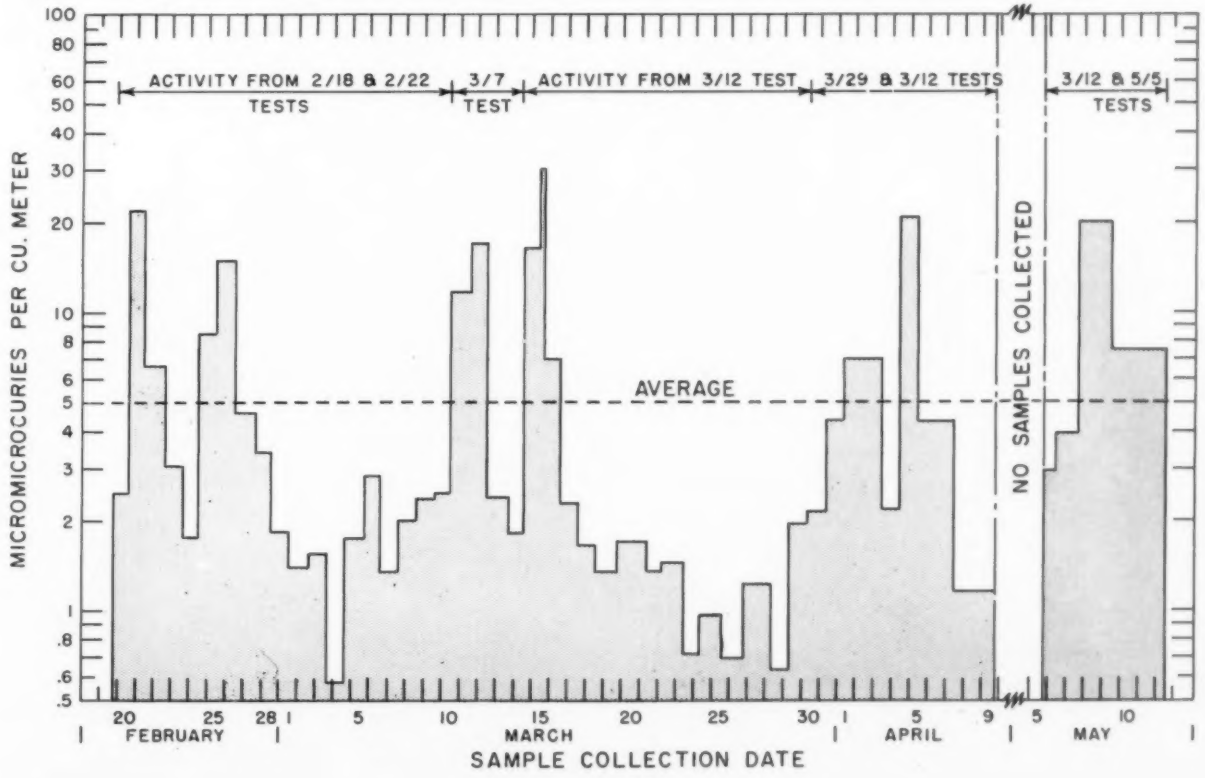
Autoradiographs of the more active particles, those which had an activity at mid-collection time greater than about 5 micromicrocuries ($\mu\mu$c.), were measured in this manner.

The minimum detectable activity by autoradiographic technique varies roughly as the square of the distance between the particle and the film emulsion. For a particle exposed for 24 hours and spaced 100 microns from the emulsion, the minimum detectable activity was estimated to be roughly 1 $\mu\mu$c. All particles having an estimated radioactivity of less than 5 $\mu\mu$c. were counted under a low-power microscope, and each was assumed to have an average activity of 2.3 $\mu\mu$c.

Gross Beta Activity

The gross beta radioactivity of particulate matter in each air sample is shown in figure

Figure 2. Gross beta activity of atmospheric particulates, Cincinnati, 1955.



2. (Gross beta activity is counted at an efficiency of 50 percent and includes gamma activity which is counted at an efficiency of 1 to 3 percent.) The lower level of beta activity found in 5 daily samples collected February 19 or later and the 2 collections made a few days before that date (not shown in the chart) ranged from 0.3 to 1 $\mu\mu$c. per cubic meter (1 $\mu\mu$c./m.^{3}=10^{-12} μc./ml.). The remaining 44 samples had an activity between 1 and 30 $\mu\mu$c. per cubic meter. Eight samples had an activity exceeding 10 $\mu\mu$c. per cubic meter. The average activity of all samples was approximately 5 $\mu\mu$c. per cubic meter.

The highest levels of activity observed in this study appeared 2 to 4 days following the reported detonation of nuclear devices in Nevada. Decay data of the air particulate samples and some rain samples were used to identify the radioactivity with specific nuclear weapons tests, as shown in figure 2.

The beta activity of particles in the primary fraction ranged from 0.08 to 17 $\mu\mu$c. per cubic meter, with an average of 1.7. The minimum value was found in the sample collected February 17. The activity of this sample had a half-life of several months. The maximum activity of a single particle was 1,700 $\mu\mu$c., found in the April 5 sample. This was the particle used for calibrating the autoradiographic technique.

Of the average activity of 5 $\mu\mu$c. per cubic meter in air particulates, an average of 1.7 $\mu\mu$c., or 34 percent of the total, was found in the primary fraction. Based on 28 samples available for comparison, from 1 to 41 percent, or an average of 16 percent, of the activity in the primary fraction was dissolved in the water used to remove the particles from the cyclone separator.

Autoradiographic Assay

Both the primary and secondary fractions of most of the samples collected from February 21 through March 19 and the sample collected on April 3 were autoradiographed after separating the water-soluble activity in the primary fraction. The autoradiographs revealed 106 active particles which were measured by photometry and 2,084 particles detected by microscopic examination.

The number of radioactive particles of variable beta activity represented an extremely small percentage of the total particles in the air, but, considering that a single person inhales 15 to 20 cubic meters of air daily, the particle radioactivity may have health significance. The variation in the number of radioactive particles in the 28 samples assayed by the autoradiographic technique is presented in figure 3. Excluding the samples of February 23 and March 1, for which only the primary fraction particles are given, the bar graph shows that all but 5 of 26 samples contained more than 1 radioactive particle per 10 cubic meters. In 5 samples there were from 16 to 82 radioactive particles per 10 cubic meters, as compared with a 26-sample average of 6.7 and a median of 4.

The beta activity of these particles ranged from an estimated minimum of 1 $\mu\mu$c. for detection by a 24-hour film exposure up to 1,700 $\mu\mu$c. for the most active particle. Three-day film exposures were also made on the samples collected February 21 and 22. About 3 times

Figure 3. Frequency of radioactive particles, Cincinnati, 1955.

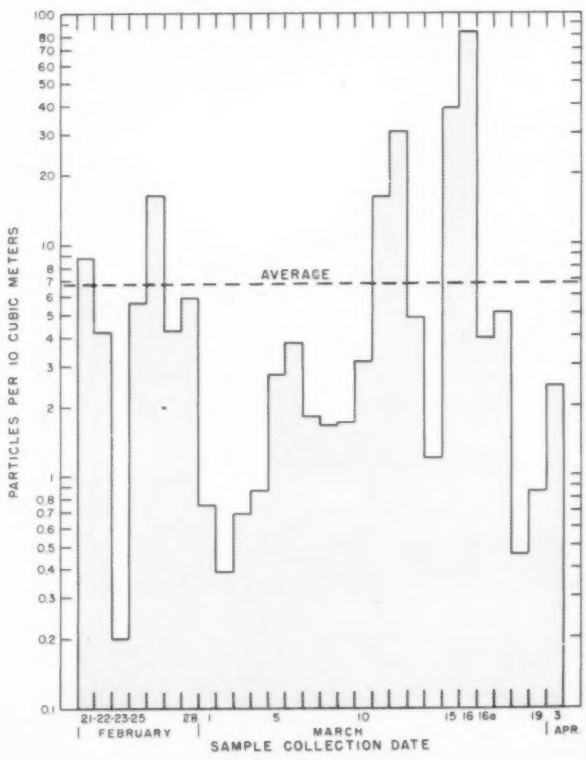
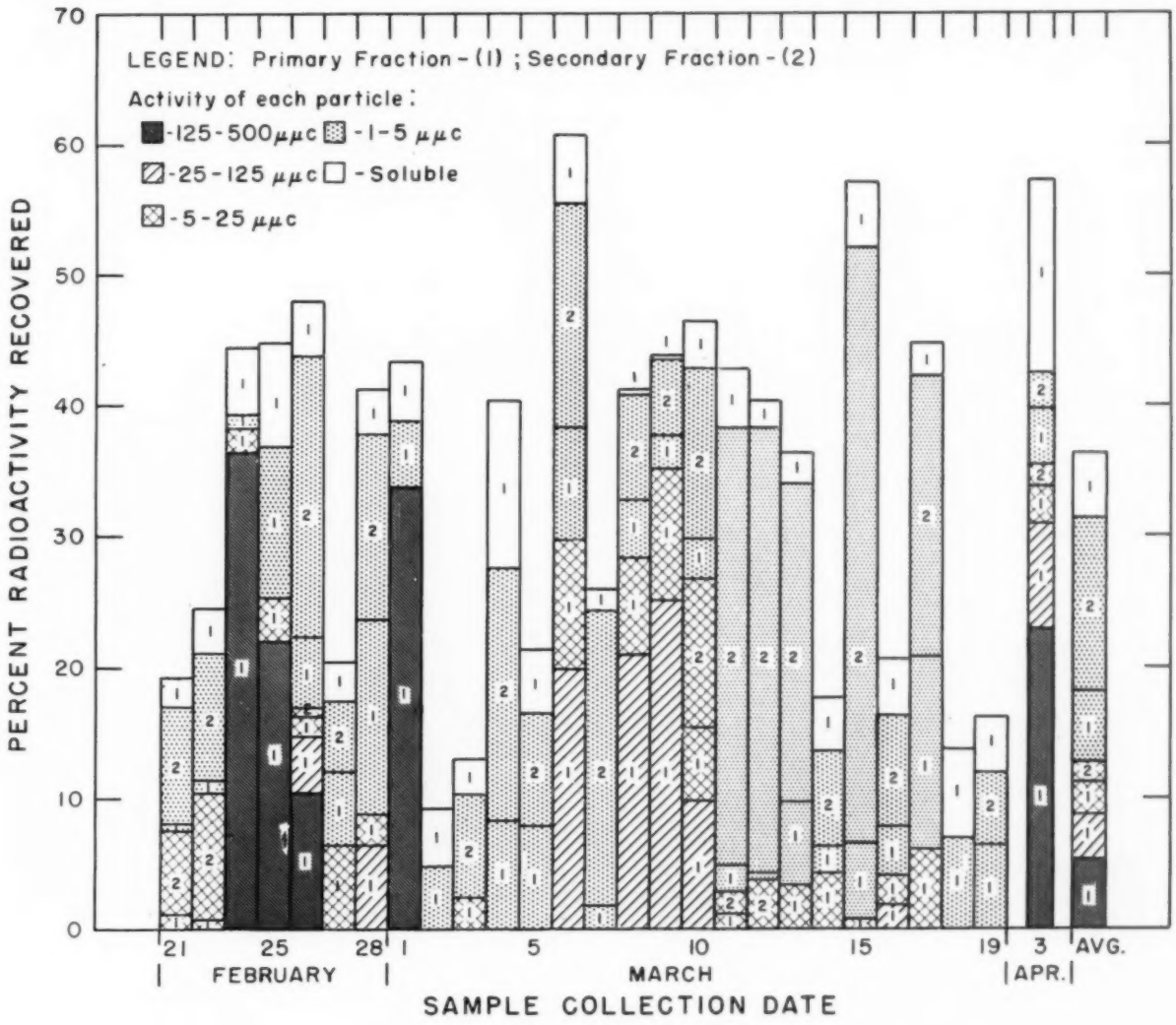


Figure 4. Radioactivity of particles as measured by autoradiographs, Cincinnati, 1955.



as many radioactive particles appeared on the 3-day autoradiographs as on the corresponding 24-hour film exposures. Thus, prolonged film exposure reveals a preponderance of particles with less than 1 μμc. of activity. It will be shown (fig. 4 and the table) that a large percentage of the total beta activity is not accounted for by the autoradiographic technique. It is likely that an appreciable part of the low-level activity from discrete particles merely increases the background fog of a 24-hour film exposure.

The particle with an estimated radioactivity of 1,700 μμc. was found in 10 percent of the primary fraction of the 24-hour sample collected at noon April 5. Subsequent autoradiographs of the entire primary sample did not reveal any more particles of activity exceeding 500 μμc. The 1,700-μμc. particle was isolated from the mass of nonradioactive particles in the sample. It was a reddish, semitransparent, nearly spherical particle having a diameter of 7.5 microns. Its decay and absorption data were characteristic of 8-day-old mixed fission product.

Distribution and Frequency

On the basis of estimates obtained either photometrically or by microscopic examination, the particles were grouped into five ranges of beta activity. The percentage distribution of

activity in each fraction and in each radioactivity range as related to the total radioactivity of each daily sample is shown in figure 4. Particles containing 125–500 μμc. were found only in the primary fraction of five samples. It is estimated that 10 to 37 percent of the total activity of these 5 individual samples resided in the "hot" particles. The samples collected March 8 and 9 each had particles with activities of 25 to 125 μμc., which accounted for 20–25 percent of their radioactivity and were recovered from the primary fraction. A considerable portion of particles in the primary fraction also had a radioactivity of 1 to 25 μμc.

The activity of particles in the secondary fraction was usually less than 5 μμc. per particle, but 6 samples had secondary-fraction particles having an activity of 5 to 25 μμc. Figure 4 shows that at most only 61 percent of the total radioactivity of a sample was observed by the autoradiographic technique. This may be explained as follows: (*a*) the secondary fraction of three samples was not autoradiographed; (*b*) particles having an activity of less than about 1 μμc. contributed only background fog to the X-ray films and this activity could not be measured; (*c*) the assumed average activity of 2.3 μμc. for particles having an activity of 1–5 μμc. each may be an underestimate; and (*d*) the autoradiographic technique is at best a rough estimate of particle radioactivity.

Occurrence of particles of given radioactivity, Cincinnati, 1955

Particle activity range, μμc.	Primary fraction		Secondary fraction	
	Maximum	Average	Maximum	Average
	Number of radioactive particles per 10 cubic meters of air			
1–5	8. 35	1. 17	73. 5	5. 2
5–25	. 38	. 12	1. 5	. 16
25–125	. 13	. 025	0	--------
125–500	. 13	. 015	0	--------
1,700	[1] . 06	--------	0	--------
	Percentage of fraction radioactivity in discrete particles [2]			
1–500	89	57	51	23

[1] One particle in 10 percent of sample had a diameter of 7.5 microns and an activity of 1,700 μμc.

[2] Based on autoradiographic technique employing 24-hour film exposure and, in the case of the primary fraction, its soluble activity which varied from 1 to 41 or an average of 16 percent of the total primary activity.

The results are further summarized in the table to show the frequency of occurrence of radioactive particles in the atmosphere tested. The most radioactive particle found (1,700 μμc.) had a diameter of only 7.5 microns. It appeared in the primary fraction and theoretically would occur at a frequency of 6 particles per 1,000 cubic meters of air, whereas a maximum of 13 and an average of 1.5 particles having an activity of 125–500 μμc. would occur per 1,000 cubic meters of air. The great preponderance of radioactive particles were found to have low activity levels of 1–5 μμc.; they were much more abundant in the secondary fraction. There were no particles in the secondary fraction which had an activity exceeding 25 μμc.

Of the radioactivity in each fraction an average of 57 percent was accounted for by autoradiography in the primary fraction, and an average of 23 percent was accounted for by autoradiography in the secondary fraction. Considering the radioactivity of both fractions, a maximum of 61, a minimum of 9, and an average of 36 percent of the total radioactivity was accountable by the autoradiographic technique.

Discussion

The maximum concentration of gross beta activity of 30 μμc. per cubic meter of air in the samples collected in this study was far below the 1,000 μμc. per cubic meter of air listed by the National Committee on Radiation Protection and Measurement as the provisional level for "permissible concentration of unknown mixtures of radioisotopes in the air . . . beyond the areas that are under the control of the installation responsible for the contamination." This value set by the committee is believed "to be safe for exposure to any of the radioisotopes for periods of a few months" (*7*).

About one-third of the total radioactivity of the air particulates collected in Cincinnati, that found in the primary fraction, would probably be retained in the upper respiratory system of

man. The rest would penetrate into the alveoli of the lungs. Presumably 50 percent might lodge in lung tissue for a variable time. Most of the particles in this secondary fraction had an activity of less than 5 $\mu\mu$c. per particle.

Some of the particles found in the primary fraction, however, might reach lung tissue. Some of these particles had much higher radioactivity than the secondary fraction particles. One particle with an activity of 1,700 $\mu\mu$c. had a diameter of 7.5 microns. Its size was such that if the particle were inhaled it would have a finite chance of reaching the alveoli. Once there, the particle would probably remain to cause considerable radiation damage to local lung tissue. When inhaled the smaller particles are more likely to reach lung tissue, but they may be eliminated by several mechanisms (*8–11*).

Summary

Radioactive particles found in air samples collected in Cincinnati following nuclear detonations in Nevada were separated into two size-fractions representative of particles retained by the upper and the lower respiratory system of man. Air sampling was continuous from mid-February until early April and again for 1 week in May 1955.

Measurements by autoradiographs and gross internal proportional counting indicated that:

1. The maximum, minimum, and average concentrations of beta activity in 47 samples collected between February 16 and April 9 and 4 samples collected between May 5 and May 12 were 30, 0.35, and 5 $\mu\mu$c. per cubic meter of air, respectively. For comparison, the maximum permissible level for unknown radioisotopes beyond the control area is 1,000 $\mu\mu$c. per cubic meter of air.

2. The average number of radioactive particles per 10 cubic meters of air was 6.7 in 26 samples collected between February 21 and March 19 and on April 3. The weighted average beta activity of these samples was 37 $\mu\mu$c. per 100 cubic meters of air. One sample contained as many as 80 radioactive particles and a beta activity of 300 $\mu\mu$c. in 10 cubic meters of air.

3. The more radioactive particles were collected by a cyclone separator, which simulates capture of particles by the nasal passages and bronchial tubes. Generally these particles would be rapidly eliminated from the human system. In roughly half of the samples tested, these particles had a gross beta activity of 25 to 500 $\mu\mu$c. and one isolated particle of 7.5 micron diameter had an activity of 1,700 $\mu\mu$c.

4. The activity of particles caught on the filter, representing material which would penetrate to the lung alveoli, was usually less than 5 $\mu\mu$c. and did not exceed 25 $\mu\mu$c. per particle.

EQUIPMENT REFERENCES

(*A*) Aerotec tube, design 2, Thermix Corp., New York, N. Y.

(*B*) Millipore filter, type HA, Millipore Filter Corp., Watertown, Mass.

(*C*) Blue Brand X-ray film, Eastman Kodak Co., Rochester, N. Y.

REFERENCES

(*1*) Harris, W. B., and Eisenbud, M.: Dust sampler which simulates upper and lower lung deposition. Arch. Ind. Hyg. & Occup. Med. 8: 446 (1953).

(*2*) Watson, H. H.: Dust sampling to simulate the human lung. Brit. J. Indust. Med. 10: 93–100, April 1953.

(*3*) Mercer, T. T.: Atmospheric monitoring for alpha emitters using molecular filter membranes. AEC Doc. No. UR–294 (Jan. 4, 1954). Arch. Indust. Hyg. & Occup. Med. 10: 372–380 (1954).

(*4*) U. S. National Bureau of Standards: Radiological monitoring methods and instrument. Handbook No. 51. Washington, D. C., U. S. Government Printing Office, 1952.

(*5*) Nader, J. S., Hagee, G. R., and Setter, L. R.: Evaluating the performance of the internal counter. Nucleonics 12: 29, June 1954.

(*6*) Nadler, N. J.: The quantitative estimation of radioactive isotopes by autoradiography. Am. J. Roentgenol. 70: 814, November 1953.

(*7*) U. S. National Bureau of Standards: Maximum permissible amounts of radioisotopes in the human body and maximum permissible concentrations in air and water. Handbook No. 52. Washington, D. C., U. S. Government Printing Office, 1953.

(*8*) Abrams, R., Seibert, H. C., Potts, A. M., Lohn, W., and Pastel, S.: Metabolism of inhaled fission product aerosols. AEC Doc. No. MDDC–248. Washington, D. C., U. S. Atomic Energy Commission, 1946. In AEC depository, on microcards.

(*9*) Cember, H., Hatch, T. F., Watson, J. A., Grucci,

T., and Bell, P.: The elimination of radioactive barium sulfate particles from the lung. A. M. A. Arch. Indust. Health 13: 170, February 1956.

(*10*) Scott, K. G., Axelrod, D., Crowley, J., and Hamilton, J. G.: Deposition and fate of plutonium. Uranium and their fission products inhaled as aerosols by rats and man. Arch. Path. 48: 31 (1949).

(*11*) Stockinger, H. E., Steadman, L. T., Wilson, H. B., Sylvester, C. E., Dzinba, S., and LaBelle, C. W.: Lobar deposition and retention of inhaled insoluble particulates. A. M. A. Arch. Indust. Hyg. 4: 346 (1951).

Regional Medical Directors Reassigned

The Public Health Service has announced a series of changes among medical directors assigned to the regional offices of the Department of Health, Education, and Welfare. The changes will become effective July 1, 1958.

Dr. Francis J. Weber, medical director of Region 8, with headquarters in Denver, Colo., has been appointed chief of the Service's newly created Division of Radiological Health in Washington, D. C.

Dr. Michael Pescor, present medical director of Region 7, with headquarters in Dallas, Tex., will become medical director of the Denver office.

Dr. Richard Boyd, now medical director of Regions 1 and 2, stationed in New York City, will assume the same position in the Dallas office.

Dr. Harald M. Graning, medical director of Region 5, in Chicago, will move into the New York City position.

Dr. Arthur B. Price, at present on loan from the Public Health Service to the Bureau of Old-Age and Survivors Insurance, Social Security Administration in Baltimore, will become the medical director of the Chicago office.

The medical directors of other regions are: Dr. Eugene Gillis, Region 3, Charlottesville, Va.; Dr. Will H. Aufranc, Region 4, Atlanta, Ga.; Dr. Lewis H. Hoyle, Region 5, Kansas City, Mo.; and Dr. Charles F. Blankenship, Region 9, San Francisco.

The medical directors in the regional offices direct Public Health Service programs of grants and technical assistance and other relationships with the States and Territories that comprise each region.

Diphtheria in the United States in 1956

HELEN A. MOORE, M.D.

DURING the autumn of 1955 and the early winter of 1955–56, diphtheria occurred in the Nation with a frequency not witnessed for a number of years. Fear of a definite resurgence was aroused when outbreaks occurred in areas which had been almost entirely free of the disease for extended periods. The particularly high incidence of the disease in the southeastern States has been described in a previous report (*1*) prepared at the close of 1955. It is the purpose of this paper briefly to summarize the United States diphtheria experience in 1956.

Data on the occurrence of diphtheria cases and deaths were obtained primarily from publications of the Public Health Service's National Office of Vital Statistics, *Morbidity and Mortality Weekly Reports* and their annual supplements and *Vital Statistics of the United States.* More detailed information was obtained from current communicable disease reports prepared by States for internal use and from the annual communicable disease statistics published by most States. Additional details were collected by personnel of the Communicable Disease Center in connection with field assignments which dealt directly or indirectly with diphtheria. The assembling and review of such data are continuing functions of the Surveillance Section of the Center.

The occurrence of diphtheria in 1955 and 1956, by weeks, is given in figure 1, and the States contributing heavily to the weekly peaks are also indicated. During the first half of 1956 diphtheria incidence continued to be relatively high and was above that of the preceding year in about two-thirds of all weeks. Following the seasonal low, however, the expected pattern of early increase of diphtheria cases in the southern States did not develop to the usual extent. Incidence remained well below that of 1955 throughout the fall and winter, and at the close of the year 1,581 cases had been tentatively reported, compared with 2,039 cases in 1955. Data for 1956 in figures 2 and 3 and table 1 are also preliminary. Although final figures for 1956 are now available, they do not alter the pattern or change the conclusions since they change the total by less than 1 percent.

This 22 percent decrease in the incidence of diphtheria restores somewhat the trend of the last decade. After the last increase in reported diphtheria in 1945 there was a fairly steady decline at about 25 percent per year until 1953. In this year the decrease was only 20 percent. In 1954 it was 13 percent and in 1955 only 3 percent. The small drop in cases for the calendar year does not give as clear a picture as the statistics for the disease years. For the disease season of 1955–56, there was actually a 12 percent increase over the disease year 1954–55. The decline in cases in the calendar year of 1956 was due almost entirely to decreases in the last half of the year and in the southeastern States.

In figure 2 and table 1, diphtheria morbidity rates are shown by standard geographic divisions and by States for 1949–56. The areas showing the greatest decline in 1956 were the South Atlantic and East South Central States. Small decreases, or essentially no change, occurred in all other divisions except the East North Central and the Mountain States, which showed increases of 0.6 cases per 100,000 population.

The increased rate in the East North Central division is almost entirely due to increases in

Dr. Moore is chief of the Diphtheria Unit, Surveillance Section, Communicable Disease Center, Public Health Service, Atlanta, Ga.

the States of Michigan and Indiana (fig. 3 and table 1). The rise in the Mountain States is attributable to an increase of 4 cases per 100,000 population in the reported incidence of diphtheria in New Mexico.

The prominence of the southern States in the persistent reporting of diphtheria is not greatly changed. In 1955, 74 percent of the Nation's cases were reported from the three southern divisions. In 1956, only 57 percent of the total occurred in this area but, again, this change only restores a previous relationship which was exaggerated in 1955.

Brief descriptions of diphtheria experience from localities (counties) reporting 10 or more diphtheria cases in 1956 are found in table 2. A county rate of 20 per 100,000 is used as a demarcation so that such local rates occurring in 1956 may be compared with those of 1955, as previously reported (*1*). In 1955, 19 localities had rates of 20 per 100,000 or higher. In 1956, only 9 localities reported cases at this or a higher rate.

A distinct localization of these sharp disease episodes to the area east of the Mississippi River and south of the Ohio River was noted in 1955. Fourteen of the 19 outbreaks occurred in this area. In 1956, only three episodes occurred in

Figure 2. Reported diphtheria cases per 100,000 population, by major geographic divisions of the United States, 1949–56.

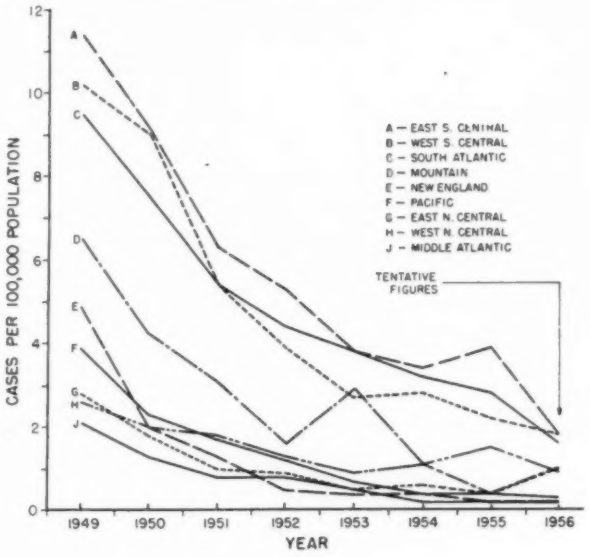


Figure 1. Reported diphtheria cases in the United States, by week of report, 1955 and 1956.

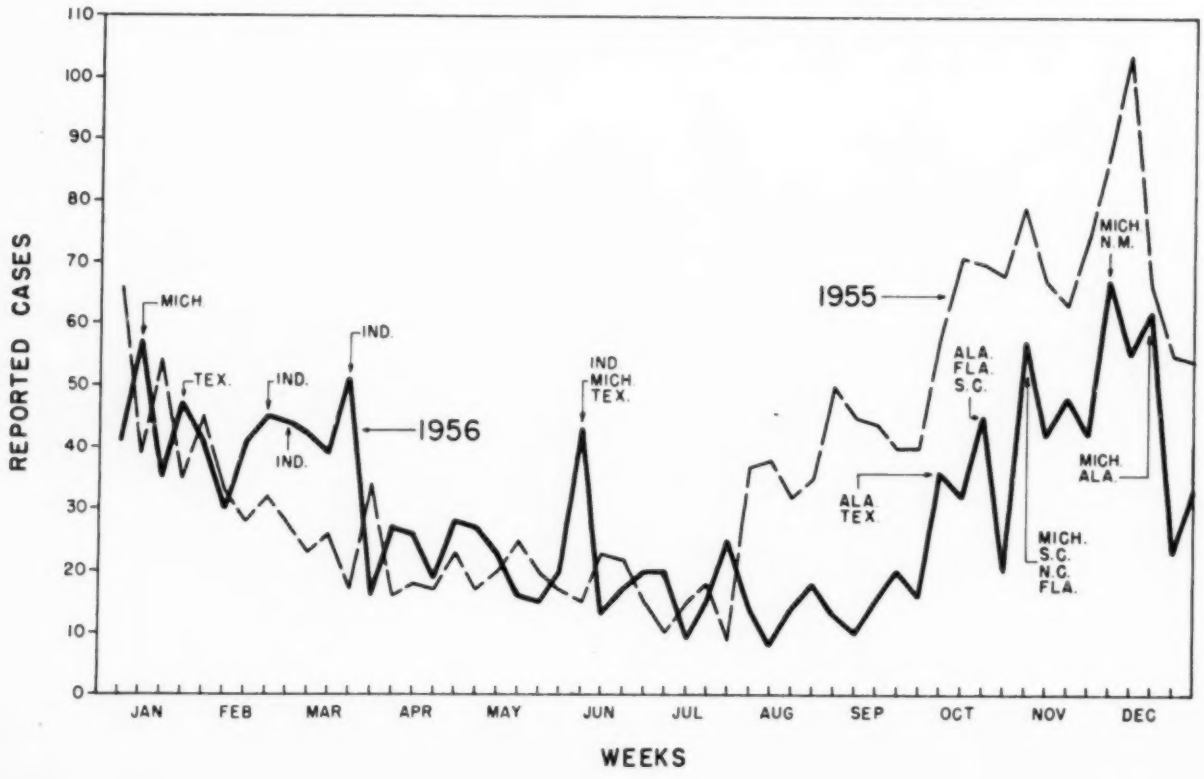
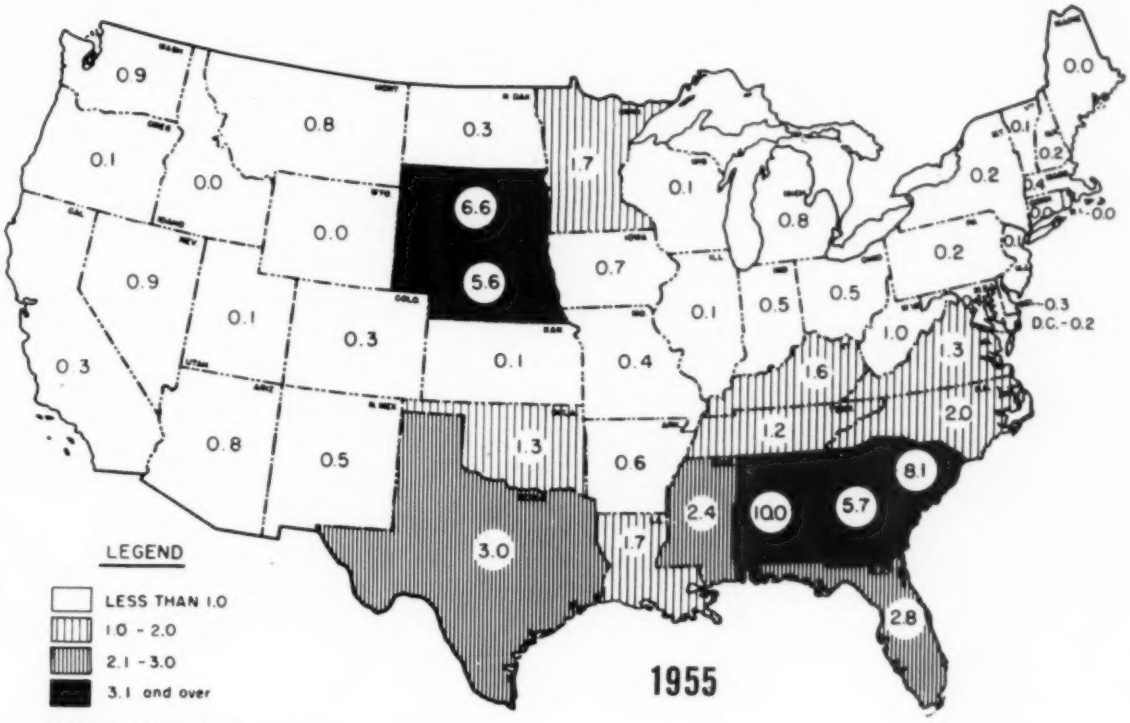
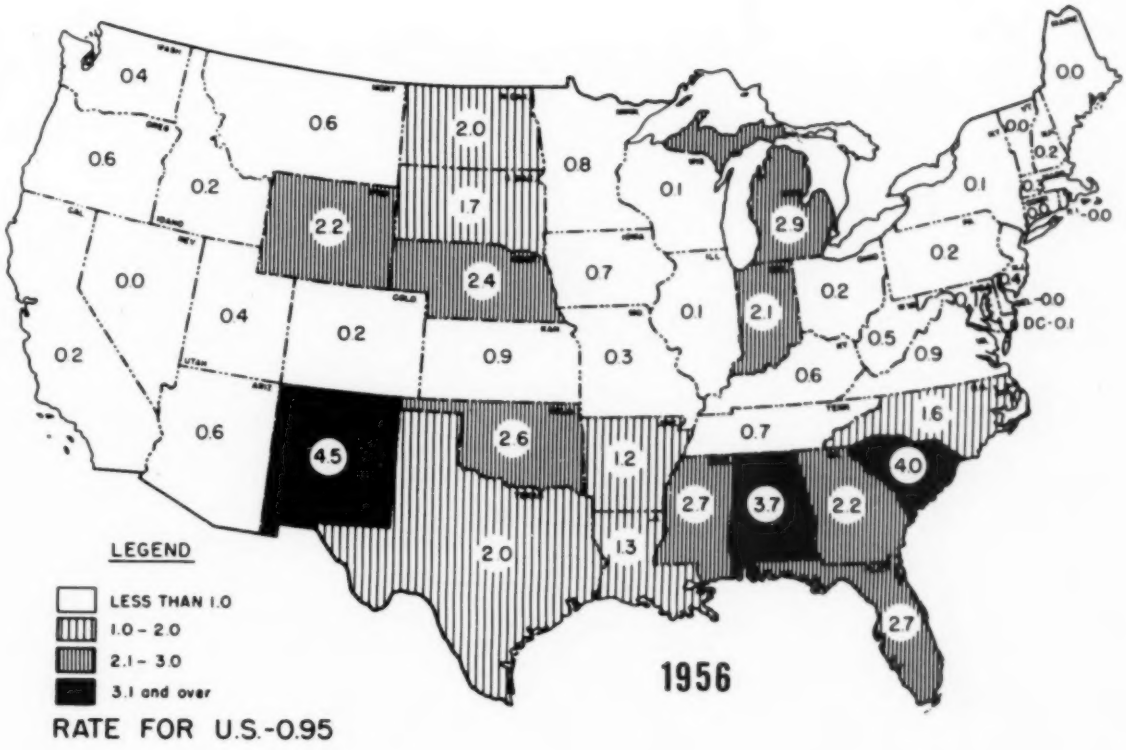


Figure 3. Reported diphtheria cases per 100,000 population, United States, 1955 and 1956.





the same area. In table 2 it can be seen that one of these (Charleston County, S. C.) was a continuation of an outbreak which began in 1955, and the current rate in Charleston County, while high, is a considerable decrease from 1955. One (Pickens County, Ga.) is of doubtful authenticity and one (Calhoun County, Ala.) appears to be an actual sporadic outbreak beginning in 1956.

The occurrence of 64 cases of diphtheria in and about Michigan City, Ind., was a particularly sharp deviation from the recent experience of the area. The same was true of the incidence in Chaves County and Bernalillo County (Albuquerque), N. Mex.

Other areas in which the incidence of 1956 was unexpectedly high were Mercer County (Trenton), N. J., Wyandotte County (Kansas City), Kans., Hillsborough County (Tampa), Fla., and Nueces County, Tex., but probably the most marked departure from recent trends occurred in the State of Michigan. Two counties, Kalamazoo and St. Clair, experienced noteworthy increases in cases and in Wayne County (Detroit) an outbreak of considerable size took place.

Within the city of Detroit 141 cases of diphtheria occurred during October, November, and December 1956, and a total of 167 cases were reported during the year. This was a ninefold increase over the median expectancy of the last 7 years. One hundred of the cases originated in an area of six census tracts in the southwestern section of the city. The area is se-

Table 1. Geographic distribution of diphtheria in the United States, 1955 and 1956

Geographic division and State	1956		1955		Geographic division and State	1956		1955	
	Cases [1]	Rate per 100,000 [2]	Cases [1]	Rate per 100,000 [2]		Cases [1]	Rate per 100,000 [2]	Cases [1]	Rate per 100,000 [2]
Total	1,581	0.95	1,984	1.2	**South Atlantic—Con.**				
					Virginia	32	.9	45	1.3
New England	**17**	**.2**	**21**	**.2**	West Virginia	10	.5	20	1.0
Maine	0	0	0	0	North Carolina	69	1.6	85	2.0
New Hampshire	1	.2	1	.2	South Carolina	94	4.0	188	8.1
Vermont	0	0	1	0	Georgia	83	2.2	210	5.7
Massachusetts	16	.3	19	.4	Florida	102	2.7	99	2.8
Rhode Island	0	0	0	0	**East South Central**	**212**	**1.8**	**453**	**3.9**
Connecticut	0	0	0	0	Kentucky	17	.6	49	1.6
Middle Atlantic	**67**	**.2**	**54**	**.2**	Tennessee	23	.7	42	1.2
New York	22	.1	30	.2	Alabama	115	3.7	311	10.0
New Jersey	24	.4	6	.1	Mississippi	57	2.7	31	2.4
Pennsylvania	21	.2	18	.2	**West South Central**	**297**	**1.8**	**349**	**2.2**
East North Central	**341**	**1.0**	**136**	**.4**	Arkansas	22	1.2	11	.6
Ohio	21	.2	43	.5	Louisiana	38	1.3	49	1.7
Indiana	92	2.1	21	.5	Oklahoma	59	2.6	29	1.3
Illinois	10	.1	10	.1	Texas	178	2.0	260	3.0
Michigan	216	2.9	59	.8	**Mountain**	**62**	**1.0**	**25**	**.4**
Wisconsin	2	.1	3	.1	Montana	4	.6	5	.8
West North Central	**137**	**.9**	**218**	**1.5**	Idaho	1	.2	0	0
Minnesota	27	.8	54	1.7	Wyoming	7	2.2	0	0
Iowa	18	.7	19	.7	Colorado	4	.2	5	.3
Missouri	14	.3	17	.4	New Mexico	37	4.5	4	.5
North Dakota	13	2.0	2	.3	Arizona	6	.6	8	.8
South Dakota	12	1.7	45	6.6	Utah	3	.4	1	.1
Nebraska	34	2.4	78	5.6	Nevada	0	0	2	.9
Kansas	19	.9	3	.1	**Pacific**	**55**	**.3**	**66**	**.4**
South Atlantic	**393**	**1.6**	**662**	**2.8**	Washington	12	.4	23	.9
Delaware	0	0	1	.3	Oregon	11	.6	1	.1
Maryland	2	.1	12	.4	California	32	.2	42	.3
District of Columbia	1	.1	2	.2					

[1] Preliminary reports.

[2] U. S. Bureau of the Census: Population estimates. Series P-25, Nos. 145 and 148. Washington, D. C., U. S. Government Printing Office, 1956.

SOURCE: Morbidity and Mortality Weekly Reports (National Office of Vital Statistics), January 4, 1957; Annual Supplement, September 27, 1957.

Table 2. Counties reporting 10 or more diphtheria cases per 100,000 population, United States, 1956

Time	State	County	Cases	Rate	Remarks
Over 20 cases [1]					
February–April	Indiana	La Porte	54	70.3	49 cases from nonofficial reports. 26 cases within Michigan City. 23 cases in adjacent rural areas. Sharp increase from 0 cases in 1955.
March–April	Indiana	Porter	10	25.0	12 cases from nonofficial reports. All from rural area adjacent to Michigan City. Increase from 0 cases in 1955.
February–April	Oklahoma	Pittsburgh	13	31.7	Increase from 8 cases in 1955.
May–June	Texas	San Patricio	10	27.9	Increase from 2 cases in 1955; 6 cases in 1954. Adjacent to Nueces County below.
October–November	Alabama	Calhoun	18	22.6	Increase from 1 case in 1955.
November–December	New Mexico	Chaves	14	34.5	Increase from 0 cases in 1955.
October and scattered cases.	South Carolina	Charleston	43	26.1	Continuation of an episode which began in 1955. Decrease from 99 cases in 1955.
Around the calendar	Texas	Hidalgo	38	23.7	Continuation of an episode which began in 1955. No change in cases or rate.
Around the calendar	Georgia	Pickens	12	135.5	No case confirmed in the laboratory. Very unusual distribution in time for area of low population density.
Under 20 cases [1]					
January–February	Michigan	Kalamazoo	11	8.7	Increase from 1 case in 1955.
February–March	Minnesota	Hennepin	11	1.6	Essentially no change from 1955.
February–April	Michigan	St. Clair	18	19.7	Increase from 5 cases in 1955.
May–June and scattered cases.	California	Los Angeles	12	1.0	Essentially no change from 1955.
May and November	New Jersey	Mercer	12	5.2	Increase from 0 cases in 1955.
September–October and scattered cases.	Texas	Nueces	20	12.1	Sharp increase from 1 case in 1955. Reported 30 cases in 1954.
October–November and scattered cases.	Alabama	Mobile	10	4.3	Decrease from 19 cases in 1955.
October–December and 1957.	Michigan	Wayne	172	7.1	Sharp increase from 27 cases in 1955. Two distinct areas of Detroit involved and 2 different types of organisms found.
October–December and scattered cases.	Alabama	Jefferson	18	3.2	Decrease from 51 cases in 1955.
November	Kansas	Wyandotte	12	7.3	9 cases from one school. Children were 67 percent Schick negative. Increase from 0 cases in 1955.
November–December	New Mexico	Bernalillo	15	10.3	22 cases from nonofficial reports. 21 cases from circumscribed area in city of Albuquerque.
Around the calendar	Florida	Hillsborough	24	9.6	Increase from 11 cases in 1955.
Around the calendar	Nebraska	Douglas	21	7.5	Continuation of an episode which began in 1955. Decrease from 63 cases in 1955.
Around the calendar	Florida	Duval	18	5.9	Decrease from 26 cases in 1955.
Around the calendar	Texas	Harris	17	2.1	Essentially no change from 1955.
Around the calendar	Washington	King	10	1.4	Decrease from 19 cases in 1955.
Around the calendar	New York	New York	21	1.1	Decrease from 31 cases in 1955.

[1] Rates on census of 1950.

SOURCE: Statistics Section, Communicable Disease Center, Public Health Service.

verely congested and housing is generally substandard.

Of the 141 cases occurring during the outbreak period, 126, or 89 percent, were mild. Only 15 persons were moderately or severely ill. There were four deaths. Cultures positive for *Corynebacterium diphtheriae* were obtained from 101 of the 141 patients and from many

460321—58——5

carriers. Two types of organisms were found and the two strains were greatly different in toxogenicity (virulence).

There had not been what could be construed as serious neglect of immunization in the area of the outbreak, although the immunization levels were not as high as in some other areas of the city. Some contiguous census tracts with the same, or lower, immunization rates were not affected by the outbreak. Again, it was demonstrated that diphtheria can occur in outbreak proportions in places where the immunization levels are at or above those currently thought to be "adequate."

Summary

1. An increase in reported diphtheria during the disease year of 1955–56 is noted. During the first half of the disease year of 1956–57, including the seasonal peak, weekly incidence was well below that in the preceding year.

2. Diphtheria morbidity rates for 1956 fell most noticeably in the South Atlantic and East South Central States. Increases were noted in the East North Central and the Mountain States.

3. Localized diphtheria outbreaks decreased in the Southeast and increased in other areas but the total of such episodes in the Nation was lower than in 1955.

The relative absence of localized sharp outbreaks of diphtheria in rural regions of the southeastern States must account for a portion of the decrease in this area. A sparing effect from the preceding high season might be postulated; however, it has been noted that such outbreaks seldom affect the same locality or even adjacent localities in successive years. Decreases were noted also in some of the southern population centers which have been persistent foci. If this be accounted an expected cyclic variation, it is not one which has been very obvious in recent years (fig. 2).

4. The recurrence of outbreaks in northern urban centers might be taken as a fairly ominous sign; one calling for an "agonizing reappraisal" of present definitions of "adequate" immunization levels.

REFERENCE

(1) Moore, H. A., and Larsen, G. L.: Present distribution of diphtheria in the United States. Pub. Health Rep. 72: 537–542, June 1957.

Institutes on Nuclear Energy

Nine institutes on nuclear energy for engineering educators will be held in the summer of 1958 at universities and laboratories throughout the Nation. Sponsored by the Atomic Energy Commission and the American Society for Engineering Education, the institutes will provide special training in nuclear energy and the nature of nuclear reactor problems which the educators can incorporate into their teaching.

There will be 4 basic courses for those with no background in nuclear energy, 4 advanced courses, and a basic course for teachers in technical institutes. Applications for the institutes can be obtained from deans of engineering or the society's headquarters. Address W. Leighton Collins, Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill.

These stinging insects, nuisances as well as agricultural pests, can be controlled through intensive and extensive measures.

The Imported Fire Ant

F. G. FAVORITE, M.P.H.

THE IMPORTED fire ant (*Solenopsis saevissima richteri* Forel) (*1*), of concern to agriculture in the southeastern United States, is also a public health nuisance. Its sting is almost as painful as a honeybee's and can cause an anaphylactoid reaction.

These stinging ants, now reported in North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Tennessee, Louisiana, and Texas,were first introduced into the United States at Mobile, Ala., around 1920 (fig. 1). Presumably the ants gained entry into the country as stowaways on vessels arriving from South America, the normal habitat of this species (*2*).

The imported fire ant cannot and is not being ignored. To control it, the Federal Government has designated $2,400,000 in matching funds for States that suffer from infestations. Alabama has allocated $155,000; Georgia, $250,000; and bills for funds have been presented in other State legislatures. Both intensive and extensive measures will be required to halt this insect short of its geographic reproduction limit.

The imported fire ant is not unlike many other ants in general appearance, but it differs considerably in habits and microstructure. The fire ants are classed as medium sized. The worker minors, females of immature colonies, average approximately 1/8 inch in length, whereas the worker majors, females, usually sterile, of mature colonies, average 1/4 inch. The basic color varies by geographic location from rust red to dark brown.

Identification of the imported fire ant is dependent upon careful examination to separate it from closely related species of the genus *Solenopsis*. The major form of *S. geminata*, the tropical fire ant, has an extremely large head out of proportion to the rest of the body and mandibles usually without teeth. Its antennal scape (the first segment of the antenna) reaches only one-half to two-thirds the distance to the posterior margin of the head. In the major form of *S. xyloni*, the southern fire ant, the mandible usually has three teeth and its antennal scape does not extend beyond two-thirds the distance to the posterior margin of the head.

The major form of *S. saevissima richteri*, the imported fire ant, normally has four mandibular teeth, and its antennal scape extends two-thirds or more the distance to the posterior margin of the head (fig. 2).

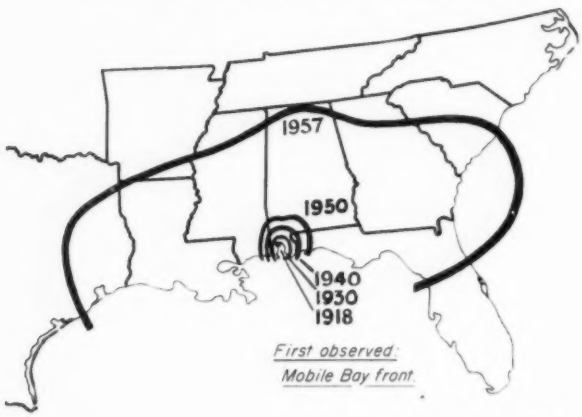
Biology

The imported fire ant's nest, or mound, also identifies it, for these ants do not build an elevated mound with the central entrance common to many other species. Fire ant mounds vary in construction to suit the environment. When the colony is free to develop without interference, the mound grows to a height of 18 to 24 inches with a basal diameter of approximately 24 inches. The active mound becomes hard in texture after alternate wetting and baking from exposure. The hardened mounds have caused damage to farming equipment (*3*, *4*).

When colonies develop in lawns where they

Captain Favorite, MSC, U. S. Army, is chief of the Entomology Section, 3d Army Medical Laboratory, Fort McPherson, Ga.

Figure 1. Spread of the imported fire ant in the southeastern United States, 1918–57.



U. S. Department of Agriculture

are frequently disturbed by grass-cutting equipment, the ants modify the architecture of the mound to a spreading nest, irregular in shape, covering 3 to 5 square feet, and rarely more than an inch or two high. On slopes where grass cutting is infrequent, the colonies usually select a hillock or a raised clump of weeds for the mound. When it is repeatedly disturbed or when its food supply becomes scarce, the colony moves to a new location, usually within 25 feet of the original site. Or the colony divides into 2 or 3 smaller ones, and the ants rebuild each colony to maximum strength.

Mature fire ant colonies house as many as 25,000 insects. In the colonies I observed, the greatest proportion of the ants were worker majors equipped with a pugnacious temperament and competent stinging apparatus. Several queens may be in the same colony.

In feeding habits the ants are practically omnivorous. Primary food is obtained from the seedlings, roots, and subsurface portions of plants and grasses (*3–5*). There are also records of ants attacking clutches of eggs, entering the pipped eggs, and feeding on the young within (*4, 5*).

Effect on Persons

When the fire ant mound is disturbed, the insects bubble forth in the thousands and within seconds the colony can administer 3,000 to 5,000 stings on an invader. The ants move rapidly, sting almost immediately on contact with the skin, and are prone to sting 3 or 4 times.

Normally, the ant seizes with its mandibles an anchor on a hair or the skin, quickly moves the abdomen under itself, and drives the stinger into the skin. The stinger remains implanted for 3 to 7 seconds before it is withdrawn, and the ant either pivots on its mandibular anchor or moves a short distance to repeat the stinging process. Second and third stings are usually of less duration but still quite painful.

Reports have said that the ant uses its mandi-

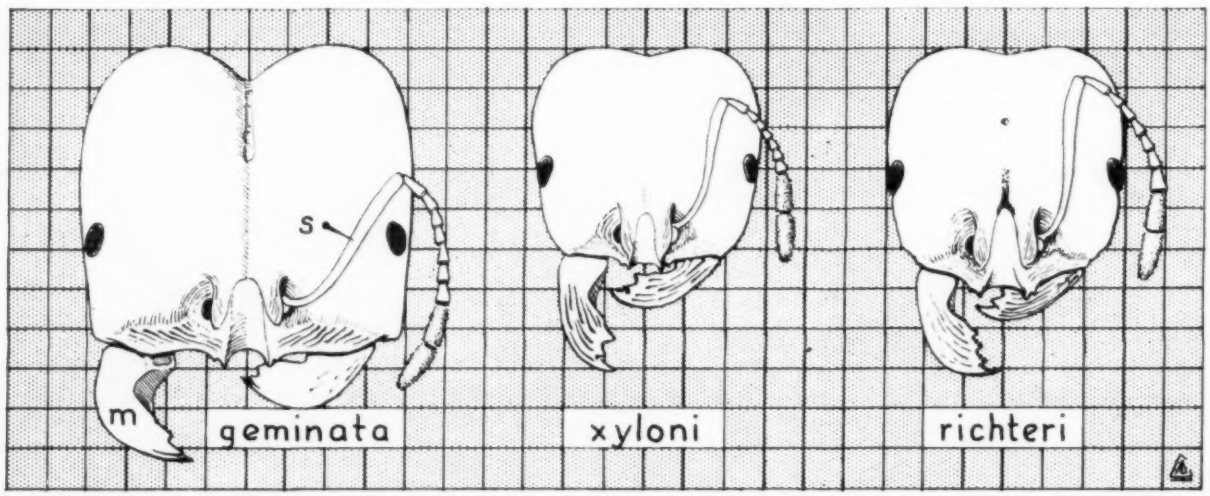


Figure 2. Distinguishing characteristics of three species of Solenopsis: S. geminata the tropical fire ant, S. xyloni the southern fire ant, and S. richteri the imported fire ant (m=mandible, s=scape).

bles to make an incision to receive the stinger (*5*). My observation of stings received while preparing this study differs from these reports; discrete stings were received while the mandibular anchor was retained.

Insertion of the stinger brings immediate pain almost comparable to the sting of a honeybee. Within several minutes a wheal, 4 to 8 mm. in diameter, appears. The stinging sensation usually subsides by the time the wheal appears. Within 24 hours a pustule, 2 to 3 mm. in diameter, forms in the center of the wheal. The pustule persists for 3 to 8 days until the purulent material is absorbed or sloughed. Each sting leaves a smooth pink area 2 to 4 mm. in diameter for several weeks until the gradual formation of scar tissue takes place (fig. 3).

During 1957 at Fort Benning, Ga., where most of my observations were made, approximately 300 persons, mainly dependents of military personnel, reported for medical care of imported fire ant stings. The majority of these persons received their stings on the lower leg and forearm while they were working or playing near their residences.

Five persons, 2 adults and 3 children, manifested anaphylactoid-type reactions. One girl reacted severely to a fifth sting, although she demonstrated no sensitivity to any of four previous stings. Following the fifth sting she suffered total body edema, cyanosis around the mouth, and respiratory embarrassment. An adult male fainted 3 times shortly after receiving 4 stings about the ankles. On examination hives were observed.

Treatment of children by parenteral route with 1:1,000 epinephrine graduated in dosage from 0.1 cc. in infants to 1.0 cc. when the child's weight exceeds 100 pounds, and of adults with 1.5 cc. of injectable benadryl solution (15 mg.) by deep intramuscular route, plus oral administration of antihistamines in both groups, has been successful in controlling most reactions to fire ant stings.

While this study was being prepared, a second instance of imported fire ant infestation of a military installation occurred at Fort McPherson, Ga., approximately 100 miles from Fort Benning. The ants were observed by a medical officer who had attended an orientation on the problem some 10 days earlier. Because

Dr. V. J. Derbes and Dr. R. C. Jung, Tulane University School of Medicine

Figure 3. Fire ant stings at 72 hours.

it had been quickly identified, the colony was treated while it was still immature, the majority of the ants being worker minors; it is believed that the infestation was eradicated before it had the opportunity to spread.

Even so, in the 24 hours between discovery and treatment the colony had moved approximately 4 feet from the original site. Considerable motor vehicle travel between the two military posts clearly provided a means of transportation for the imported fire ant. Local increases also occur during the spring mating season when the winged queen, having mated in flight, starts a new colony wherever she alights.

Control

Granular formulations of hydrocarbon insecticides seem to offer more promise for control than any other method. Both dieldrin and heptachlor at 5 percent concentration, spread

at the rate of 40 pounds per acre, obtaining 2 pounds of technical material per acre, were successfully used during the summer of 1957. Chlordane has been used at the rate of 4 pounds of technical material per acre (*6–8*). Seeding machinery or another type of equipment which affords an even coverage can be utilized for spreading. I feel that watering the ground following treatment is essential to gain dispersion of the chemical and reduce the toxic hazard to human beings and domestic animals.

In addition, mounds should be treated individually by excavation, direct insecticide application, and watering. However, mound treatment alone cannot be relied upon for eradication. Following such treatment the ants move from the immediate area and the survivors establish a new colony.

Previously treated areas indicate that the method of spreading and treating mounds individually with insecticides will prove effective for at least 2 years (*7*), when preventing reinfestation may be necessary. The cost of the control program will vary with the insecticide selected, method of application, and the cost of labor in the community, but experience indicates that an average figure in the southeast would be approximately $5 per acre.

The use of a toxic chemical introduces another public health hazard, but if the chemical is applied by qualified personnel under proper supervision, the hazard can be nullified.

REFERENCES

(*1*) Creighton, W. S.: The new world species of the genus *Solenopsis*. Proc. Am. Acad. Arts & Sc. 66: 87–89 (1930).

(*2*) Eden, W. G., and Arant, F. S.: Control of the imported fire ant in Alabama. J. Econ. Ent. 42: 976–979, December 1949.

(*3*) Blake, G. H., Jr., and others: Control of the imported fire ant in the black belt area of Alabama. Preliminary report. Auburn, Alabama Polytechnic Institute, Agricultural Experiment Station, April 1956.

(*4*) Foster, J.: Secrets of the fire ant. Miss. Game & Fish 20: 4–5, July 1957.

(*5*) U. S. Department of Agriculture: The imported fire ant, how to control it. Department of Agriculture Leaflet No. 350. Washington, D. C., U. S. Government Printing Office, March 1954.

(*6*) Hutchins, R. E., and Green, H. B.: The imported fire ant. Mississippi Agricultural Experiment Station, Information Sheet 562. State College, Miss., May 1957.

(*7*) Blake, G. H., Jr.: Imported fire ant; On the march in Alabama. Highlights Agric. Res. 3: 5, Fall 1956.

(*8*) Arant, F. S., and Eden, W. G: Control of the imported fire ant. Alabama Polytechnic Institute. Prog. Rep. Series No. 42. Auburn, December 1949.

Environmental Engineering Curriculum

Rensselaer Polytechnic Institute in Troy, N. Y., will offer full programs in the newly developed field of environmental engineering beginning in the fall of 1958.

At that time, a 4-year undergraduate curriculum leading to the degree of bachelor of environmental engineering and graduate courses leading to advanced degrees will be put into effect.

The object is to train engineers to meet environmental problems created by a growing population, industrial expansion, and increased urbanization.

Water conservation, food supply, air pollution control, and problems associated with the nuclear industry will be studied. Other courses will deal with industrial safety, waste treatment and disposal, housing, insect and rodent control, and research.

The new curriculum was developed in consultation with engineers and health officials at all levels of government.

Mandatory Federal inspection of poultry will not eliminate all unfit poultry from the consumer market. States and municipalities have the major responsibility for regulating the poultry industry's intrastate production and distribution.

Federal and State Poultry Programs

JOE W. ATKINSON, D.V.M.

ALL GROUPS concerned agree on the need for official poultry hygiene inspection. This was demonstrated during hearings in 1956 and 1957 before five congressional committees (*1–5*). What makes such inspection necessary? What should its objectives be? How can those objectives be attained? Where do basic responsibilities rest, and what is the present picture in relation to those responsibilities?

The problems necessitating official poultry hygiene inspection and supervision fall under three general headings: diseased poultry, insanitary plants and products, and conditions not apparent to the consumer.

Diseased Poultry

Other workers (*6–10*) have dealt extensively with poultry diseases as public health problems. Therefore, it is sufficient to point out that infected birds may transmit a disease, such as psittacosis, to poultry plant employees or other persons who dress or eviscerate them, or they may serve as a source of a foodborne disease, such as salmonellosis. Consumers do not want to buy food derived from or contaminated by diseased birds, nor do plant employees wish to handle badly diseased poultry, even when there is no health hazard.

Diseased poultry originates, of course, at the farm or producer level. Reports in 1956 by the Committee on Poultry Diseases, American Veterinary Medical Association (*11*), and the Committee on Transmissible Diseases of Poultry, U. S. Livestock Sanitary Association (*12*), indicate the continuing nature of this problem. The latter report states:

"In reviewing the research work in the field of poultry diseases that has been done during the past year, one is aware that progress is being made, however slowly, in the knowledge and control of transmissible diseases of poultry. New problems, such as synovitis and ornithosis, increased in importance while others, such as hemorrhagic syndrome of chickens, decreased in incidence during the past year. In general, however, the major problems, such as leukosis, respiratory diseases, salmonellosis, and others, that have confronted us in the past are still the major problems of today."

Unfortunately, diseased poultry does not remain at the farm or producer level. Some of it goes to be processed and, unless rejected at that point, enters retail food channels.

While the vast majority of poultry sold for processing is healthy, a substantial amount is diseased. For example, the U. S. Department of Agriculture, under its voluntary poultry inspection program, inspected about 30 percent

Dr. Atkinson is consultant, Poultry Inspection and Sanitation, Milk and Food Program, Division of Sanitary Engineering Services, Public Health Service. *This paper is based on an address at the Sixth Annual Health Conference, University Park, Pa., August 20, 1957.*

of the poultry sold off farms in 1936, or more than 1.4 billion pounds. The amount rejected 11,270,951 pounds, was a little less than 0.8 percent of the total inspected. But this is a sizable amount considering the number of individual servings of poultry meat or products that could have been obtained from 11 million pounds of poultry.

What happens to diseased poultry which is processed under makeshift conditions on the farm, in retail markets, restaurants, or hotel kitchens, or in plants lacking official inspection? Obviously, the consumer has no assurance that unfit birds will be rejected in the absence of official inspection for wholesomeness. Even if financial or other personal considerations were not of primary concern to them, the persons involved seldom have the training or experience necessary to evaluate diseased poultry objectively from the health and consumer viewpoints.

A similar, related problem exists with poultry processed in the absence of continuous official supervision for sanitation.

Insanitary Plants and Products

There is some reason to believe that insanitary conditions, as well as diseased poultry, may contribute to the relatively high incidence of illness among employees in the poultry processing industry. Speaking at the Institute of American Poultry Industries Annual Fact Finding Conference in 1955, Victor Pringle, president, Associated Poultry and Egg Industries, stated: "One firm I know saved $12,000 last year in compensation insurance, by controlling infections and skin rashes, thanks mainly to a better sanitation program throughout all parts of its plants."

It must be emphasized that far too little is known about the specific illnesses which affect poultry plant workers and the exact causative factors. According to Bureau of Labor Statistics reports, the injury frequency rate in the poultry and small game dressing and packing industry is almost three times the average of 135 manufacturing industries (*13*). The scope and significance of workers' health problems call for careful study and evaluation and the application of all practicable safeguards.

With respect to foodborne disease outbreaks, also, our information is incomplete. Insanitary conditions or the lack of adequate refrigeration during processing and distributing or during preparation and serving undoubtedly cause many of the outbreaks. Here, again, the application of known sanitary safeguards should be accompanied by continuing research and epidemiological studies to delineate the problem more definitely. Of course, any of a number of conditions or operations in poultry processing establishments may cause insanitary products (*14*). These conditions are particularly significant.

- Diseased poultry slaughtered for processing may contaminate facilities, equipment, employees' hands, and otherwise clean, healthy poultry.
- Mass contamination may occur when uneviscerated (New York dressed) carcasses are held for delayed evisceration (*15–18*), particularly when chilled in water or ice slush, packed or shipped in cracked ice, or frozen and subsequently defrosted for evisceration.
- Building facilities or equipment may be inadequate for the volume or type of processing operations, making sanitation a practical impossibility. When poultry is dressed or eviscerated in retail markets, restaurants, or hotel kitchens, conditions are also conducive to contamination of other foods with feces and other wastes from the birds.
- Processing, particularly evisceration of carcasses, may be conducted at such high speeds that carcasses are frequently contaminated with feces or other filth.

These conditions, as well as others, may exist completely unknown to the ultimate consumer.

Conditions Inapparent to Consumer

Because of present marketing practices and buying habits, the average consumer has little personal knowledge concerning poultry and poultry products. This was not true years ago.

Formerly, the average family ate most of its meals in the home. The housewife selected her poultry live at the farm or market. Although not qualified to make a professional evaluation, she quickly refused any bird which did not appear to be bright and healthy. Similarly, upon

eviscerating the bird or observing its evisceration, she rejected any carcass with abscesses, tumors, obnoxious exudates, badly swollen or discolored liver, or other abnormal or questionable conditions. She could also be sure that the edible carcass and giblets were not soiled with filth during evisceration.

Today, most housewives select their poultry and poultry products, either ready-to-cook or precooked, from a large variety displayed in the retail market. In addition, many servings of poultry and poultry dishes are consumed in public eating establishments. The consumer does not see the live bird or observe its processing.

So far as consumer knowledge or surveillance is concerned, abscesses, tumors, and diseased organs or parts could be removed from unfit poultry carcasses and the remainder sold as ready-to-cook poultry. Birds which are diseased, emaciated, or so altered in appearance as to be unsalable as ready-to-cook poultry can be processed, sold, and served as one of the numerous poultry dishes that preclude even an expert's evaluation of its original condition.

Similarly, insanitation may be completely hidden from the consumer. Poultry soiled by feces or other wastes can be washed off or processed so that the ultimate consumer will never be aware of the soiling, even though a seedbed of bacteria may remain (*15*). A good example of this is New York dressed poultry. Often grossly contaminated during chilling or other handling pending delayed evisceration, a very small proportion of such poultry actually reaches the ultimate purchaser in the uneviscerated form. Much of it is finally eviscerated in processing plants or retail markets and sold to the consumer as "fresh" ready-to-cook poultry. Most of the remainder is eventually used in various precooked poultry products or served in public eating establishments to the unaware consumer.

Other less serious but nevertheless objectionable practices may be inapparent to the purchaser. For example, frozen poultry may be defrosted and sold as "fresh." Unfrozen poultry may be held too long in distribution channels and sold to the housewife as "fresh" poultry, when in fact its freshness is substantially deteriorated and its storage life practically exhausted. Such practices have even involved products treated with antibiotics to extend storage life.

Objectives of Poultry Hygiene

In view of these problems, what should be the basic objectives of official poultry hygiene programs? Health and consumer groups agree that they certainly should provide:

- Protection of the consumer's health and interests by preventing the processing, distribution, sale, and consumption of diseased, insanitary, or otherwise adulterated poultry or poultry products.
- Assurance that poultry and poultry products have not been altered or treated to conceal inferiority, that they are factually and informatively labeled, and that they are prepared, packaged, and distributed so as to protect against contamination and spoilage to the point of purchase by the ultimate consumer.
- Protection of the health of poultry industry personnel to the fullest extent practicable.

Among the specific steps that can be taken to attain these objectives are:

1. Antemortem inspection of all poultry to be slaughtered, and elimination of birds determined to be unfit for food.
2. Postmortem inspection of each carcass and its viscera at the time of evisceration, immediately following slaughtering and defeathering.
3. Inspection of the processing of poultry pies, patties, soups, dinners, and stuffed or breaded poultry.
4. Reinspection of poultry and poultry products whenever necessary to assure continued fitness for use as food.
5. Destruction or denaturing of condemned live birds and other condemned poultry and products.
6. Supervision of sanitation in processing plants and during storage and distribution.
7. Supervision of the labeling and identification of the product.
8. Cooperation between inspection agencies and livestock disease control officials to control and prevent diseases in poultry.
9. Investigation and corrective or preventive measures when foodborne disease outbreaks are attributed to poultry, and when disease out-

breaks occur among the employees of poultry processing plants.

10. Continuing research and field studies to delineate more definitely the health hazards associated with processing and consuming poultry and to develop increasingly effective safeguards.

Where Responsibility Rests

The concept of "let the buyer beware" cannot be applicable to foods. Recognizing his inability as an individual to make sure of the safety and acceptability of foods, the consumer looks to government for assurance and protection. While the food processor has a basic responsibility for his product, governmental agencies have found it necessary to provide various regulatory programs to guide and assist the food industries, and to protect against both unintentional and premeditated actions which may be detrimental to the health and welfare of the public.

In this country, State and local governments have primary responsibility for protecting the health and welfare of the citizens within their jurisdictions. Logically, this responsibility is usually assigned or delegated to the State and local health agencies. In turn, these agencies may seek, from Federal or other sources, specific assistance or guidance when research, field studies, or developmental work beyond the resources of one State or municipality is needed. The Public Health Service receives numerous requests of this nature.

On the other hand, a problem may be partly interstate in scope and can best be approached at the interstate level by the Federal Government. In either case, basic public health responsibility generally remains with the State and local health agencies. Because of the mass production and widespread distribution of many foods, this has been the pattern in food hygiene.

Thus, the Public Health Service provides technical assistance, develops program guides and training aids, conducts training courses, and engages in and supports research and investigations to aid States and municipalities in their milk and food programs. Upon the recommendation of both the Association of State and Territorial Health Officers and the U. S. Livestock Sanitary Association, the Service developed a model ordinance covering sanitation in poultry processing and marketing (*19–21*).

The Food and Drug Administration inspects poultry processing plants engaged in interstate commerce and examines products shipped interstate. For almost 30 years the Department of Agriculture has provided voluntary inspection and sanitation services (*22, 23*) to poultry processors who apply and pay fees for it and who comply with regulations. This service seldom includes antemortem inspection and may cover only part of a particular plant's operations and products.

Official supervision over plants engaged only in intrastate commerce and over food products moving only intrastate, even though originating in federally inspected plants, has remained a function of the State and local governments. An estimated 50 percent of the Nation's processed poultry remains intrastate and is not subject to the Federal Food, Drug, and Cosmetic Act.

State and local governments have adopted varying laws and regulations concerning poultry hygiene (*24*). Some have not proved to be completely effective, either because they do not cover all major factors or because of a lack of uniformity in requirements, interpretation, or enforcement by jurisdictions in respective shipping and receiving areas. Virginia and Texas have recently initiated voluntary inspection-for-wholesomeness services to poultry processing plants. However, California is the only State which has a mandatory poultry inspection service, and actual inspection in California is conducted by licensed plant owners or employees.

Federal Legislation

In 1957 Congress enacted Public Law 85–172, the Poultry Products Inspection Act. Major items in this bill are:

1. Mandatory inspection by the Department of Agriculture of all poultry processed in plants engaged in interstate or foreign commerce, inspectors to be employees of the Department or designated State employees, and all expense

(except for overtime and holiday work) to be paid through appropriations to the Department of Agriculture.

2. Application of the act to the extent deemed desirable by the Secretary of Agriculture in certain areas of intrastate commerce, to be designated by him after hearings called at the request of certain State or local official agencies or industry groups.

3. Antemortem inspection of poultry to the extent deemed necessary by the Secretary of Agriculture.

4. Postmortem inspection of the carcass of each bird processed.

5. Condemnation of unwholesome or adulterated carcasses, parts, and products, and supervision over disposition of condemned material.

6. Approved labeling, including application of inspection legend, of all containers of product passed as wholesome and unadulterated.

7. Official supervision of all sanitation facilities and practices in plants under Department of Agriculture inspection; inspection to be withheld from plants not complying with such regulations as may be promulgated by the Secretary of Agriculture.

8. Movement of uneviscerated poultry carcasses (New York dressed poultry) outside the plant where slaughtered only as authorized by and under rules and regulations prescribed by the Secretary of Agriculture.

9. Prohibition of various actions which would circumvent the intent of the law; injunction proceedings and penalties for violations.

10. Maintenance of records for 2 years on the receipt, delivery, sale, movement, or disposition of poultry or poultry products in interstate or foreign commerce or in a designated area.

11. Exemptions for (*a*) producers who sell poultry directly to household consumers or restaurants, hotels, and boarding houses for use in their own dining rooms or in the preparation of meals for sale direct to consumers only, provided that such producers buy or sell no poultry products other than those produced from poultry raised on their own farms; (*b*) retail dealers who cut up ready-to-cook poultry for sale directly on the premises to retail consumers; (*c*) other persons as deemed practicable until but not after July 1, 1960; and (*d*) persons processing poultry as required by recognized religious dietary laws, to the extent determined necessary by the Secretary of Agriculture to avoid conflict with such requirements while still effectuating the purposes of the act.

12. Regulation of imported slaughtered poultry or parts or products thereof.

13. Exemption of poultry and poultry products, insofar as regulated by the act, from the provisions of the Federal Food, Drug, and Cosmetic Act.

14. Cooperation by the Secretary of Agriculture with other branches of government and with State agencies in carrying out the provisions of the act.

15. Application of the act after January 1, 1958, to persons applying for Department of Agriculture inspection under the act and meeting all requirements; mandatory application of the act beginning January 1, 1959.

Problems Remain for States

After the new Federal law goes into effect, however, State and local agencies will still have major responsibilities for effective poultry hygiene programs.

1. The Department of Agriculture service will be provided only in processing plants; foodborne disease is often caused by mishandling of products during local distribution and in retail establishments.

2. Approximately 1,000 interstate processing plants will have Department of Agriculture service by 1960 under the new law, but there are about 2,500 intrastate plants. Some of the latter may be designated to come under the Federal law a few years from now, but the majority will remain a responsibility for State and local agencies and could become a dumping ground for diseased flocks, unless effective State and local programs are developed and maintained.

3. Certain exemptions are permitted under the Federal act which could result in the delivery of significant quantities of uninspected poultry directly to hotels, restaurants, and boarding houses. State and local ordinances

and regulations will be required to prevent such deliveries.

4. Irrespective of Federal inspection programs, State and local health departments have basic responsibility for investigating foodborne disease outbreaks attributed to poultry and poultry products and disease outbreaks among poultry plant employees, and for corrective and preventive measures.

5. Many of the public health problems associated with the processing, distribution, and consumption of poultry require research and related field investigations by health department personnel, who can plan and carry out studies correlating all essential factors.

Summary

Current methods of production and distribution of poultry and poultry products pose health and consumer problems which emphasize the need for effective, uniform poultry hygiene programs. These programs should include antemortem and postmortem inspection of poultry for wholesomeness, and supervision of sanitation in the processing and distribution of poultry and poultry products. Continuing research and field investigations will be needed to delineate health hazards associated with the processing and consumption of poultry, and to develop more effective health and consumer safeguards.

The Federal Government can provide substantial assistance to the States in poultry hygiene. The Public Health Service develops program guides and training aids, carries out and supports research and investigations, conducts training, and provides technical assistance with respect to State and local poultry sanitation. The Food and Drug Administration inspects processing plants which ship interstate, and poultry and poultry products in the channels of interstate commerce. The U. S. Department of Agriculture now provides a voluntary, industry-financed poultry inspection service; Congress has enacted a law to provide mandatory Department of Agriculture inspection in all poultry processing plants engaged in interstate commerce. But in the final analysis, State and local governments are confronted with a large part of the responsibility for establishing and maintaining effective, uniform poultry hygiene programs.

REFERENCES

(1) U. S. Congress, Senate Committee on Labor and Public Welfare: Compulsory inspection of poultry. Report of the Subcommittee on Legislation Affecting the Food and Drug Administration. 84th Cong., S. Doc. 129. Washington, D. C., U. S. Government Printing Office, 1956.

(2) U. S. Congress, Senate Committee on Agriculture and Forestry: Compulsory inspection of poul and poultry products. Hearings before a subcommittee. 84th Cong. Washington, D. C., U. S. Government Printing Office, 1956.

(3) U. S. Congress, House Committee on Agriculture: Poultry inspection. Hearings before a Subcommittee on Poultry and Eggs. 84th Cong. Washington, D. C., U. S. Government Printing Office, 1957.

(4) U. S. Congress, Senate Committee on Agriculture and Forestry: Poultry Products Inspection Act. Hearings. 85th Cong. Washington, D. C., U. S. Government Printing Office, 1957.

(5) U. S. Congress, House Committee on Agriculture: Compulsory inspection of poultry and poultry products. Hearings before the Subcommittee on Poultry and Eggs. 85th Cong. Washington, D. C., U. S. Government Printing Office, 1957.

(6) Brandly, P. J.: Poultry inspection as part of the public health program. J. Am. Vet. M. A. 112: 10–17, January 1948.

(7) Felsenfeld, O.: Diseases of poultry transmissible to man. Iowa State Coll. Vet. 13: 89–92 (1951).

(8) Brandly, C. A.: Poultry diseases as public health problems. Pub. Health Rep. 66: 668–672, May 25, 1951.

(9) Galton, M. M.: Poultry diseases transmissible to man including summary report of outbreaks. Atlanta, Ga., Public Health Service, 1953. Mimeographed.

(10) Meyer, K. F.: Watch those chickens. WHO Newsletter, November–December 1955.

(11) Lee, C. D., and others: Report of the AVMA committee on poultry diseases. J. Am. Vet. M. A. 130: 41–44, Mar. 1, 1957.

(12) Hofstad, M. F., and others: Report of the committee on transmissible diseases of poultry. Proc. Book U. S. Livestock Sanitary Association 1956: 210–223.

(13) Atkinson, J. W.: Trends in poultry hygiene. Pub. Health Rep. 72: 649–656, November 1957.

(14) Atkinson, J. W.: Status of poultry sanitation. J. Milk & Food Technol. 19: 248–251, September 1956.

(15) Gunderson, M. F.: Do the job right when you're

eviscerating poultry. U. S. Egg & Poultry Mag. 52: 253–255, 275, July 1956.
(16) Gunderson, M. F., McFadden, H. W., and Kyle, T. S.: The bacteriology of commercial poultry processing. Minneapolis, Burgess Publishing Co., 1954.
(17) Atkinson, J. W.: New York-dressed poultry. Mod. San. 8: 25, 52–53, May 1956.
(18) Atkinson, J. W.: Official poultry inspection—Public health viewpoint. Vet. Med. 52: 169–174, April 1957.
(19) Atkinson, J. W.: Development of a poultry ordinance. Pub. Health Rep. 71: 471–476, May 1956.
(20) Sullivan, T. E.: The U. S. Public Health Service model poultry ordinance and code. J. Milk & Food Technol. 18: 130–133, May 1955.
(21) U. S. Public Health Service: Poultry ordinance. Public Health Service Pub. No. 444. Washington, D. C., U. S. Government Printing Office, 1955.
(22) Atkinson, J. W.: Official poultry inspection programs. Vet. Med. 51: 212–217 (1956).
(23) Willie, R. E.: The Federal poultry inspection program. J. Am. Vet. M. A. 130: 120–122, Feb. 1, 1957.
(24) Hamann, J. A., and Wright, S. E.: Summary of State, county, and city laws and regulations for marketing poultry. U. S. Agricultural Marketing Service AMS–47. Washington, D. C., 1955, 23 pp.

Home Safety Activities

Increasing numbers of State and local health departments are recognizing that the prevention of accidents in the home is a matter for their concern.

This conclusion, reported by the National Health Council in their 1956 Home Safety Inventory, is based on a comparison with a survey undertaken by the American Public Health Association in 1955.

Only a very small percentage of the health departments consider their present programs adequate, but the wide variety of activities reported by different departments reveal a potential for extensive developments in the future.

Activities mentioned, in order of descending frequency, include assisting other groups in planning their programs, inservice training for their staffs, showing films, releasing news to the press, meetings, coordinating various programs within an area, exhibits, radio and television programs, workshops, institutes and conferences, demonstrations, research, inspections for hazards, surveys for injuries, and courses for baby sitters.

A most encouraging trend, the National Health Council said, is the extent to which local health departments are reaching directly into homes. Furthermore, almost all activities are directed mainly to the family as a whole. Two-thirds of all health units reporting indicated that their activities were part of established long-range programs.

A healthy trend is evident, the council affirmed, in the degree to which health units are cooperating with other organizations, and in the emergence of the health department as a resource in home safety.

The Home Safety Inventory revealed several weaknesses in health department programs. Few were found to be directed specifically to preschool children and the aged, in whom accidents take their largest toll. Perhaps the greatest defect, the council said, is that most programs were determined by the program directors' felt needs or by a prescribed pattern rather than by the actual needs in the community.

The council's report concludes that "the need for positive leadership in home safety on the community and State level is a definite 'must.' Because of the health departments' awareness of the problem, the skill of their technical personnel, and their resources as an official agency, they are in a unique position to provide leadership and direction in preventing accidents in the home."

Diphtheria Immunity Status In Montgomery County School Seniors and Adults

JOHN B. ATWATER, M.D., and
WILLIAM J. PEEPLES, M.D., M.P.H.

DIPHTHERIA, once primarily a disease of infants and young children, has been increasing among adults and teen-aged children over the past 20 years (*1–4*). The shift in age-specific morbidity rates can be traced to markedly decreasing exposures to virulent *Corynebacterium diphtheriae*. The almost universal artificial immunization of infants and children has resulted in less frequent natural immunity among adults.

Somewhere between the adult and the child, however, lies a zone where the protection of unreinforced early immunization begins to wear off. Outbreaks of diphtheria in Detroit, Mich., Albuquerque, N. Mex., and South Carolina in the fall of 1956, while this study was still in the planning stages, pointed up the importance of continued awareness of the disease as a public health problem (*5*, *6*). It also reemphasized the value of current data on the relative immunity of various population segments in anticipating and preventing outbreaks.

In this study we undertook specifically to determine the relative immunity to diphtheria of the young adult population in an area where only 2 cases, both in white men in their early twenties, have been reported during the preceding 2 years. The study was conducted in Montgomery County, Md., during January and February 1957.

The county, principally a suburban residential center, is northwest of the District of Columbia and has an area of about 525 square miles. Its population, growing at a prodigious rate in the postwar period with the influx of Government workers, is nearly 300,000. Of these, 6 percent are Negro. The county has the highest per capita income in Maryland.

Information gathered at the time of preschool conferences over the past 4 years reveals that about 92.5 percent of Montgomery County children have been actively immunized against diphtheria prior to registering for school, and the remainder are almost all given primary immunizations at this time (*7*). However, because of the large population influx, the inadequacy of transferred school health records, and basic doubt as to the duration of immunization in infancy and early childhood (*8*), the status of children finishing high school has been heretofore unknown. With the approval of the Montgomery County Medical Society and the superintendent of schools and the aid of the Maryland State Department of Health, the Montgomery County Health Department planned to give Schick tests to all 12th grade students in the county's nine high schools.

Procedure

Several weeks prior to the testing in the schools, each student was given a letter explaining the objectives of the testing program and the significance of the individual reactions, and requesting his parents' permission to give the Schick test. The response to the letter varied from 65 percent to 100 percent of the enrollment in different schools.

The actual testing and reading of the reactions was done by a single health department physician. The antigens used, obtained from the biologic laboratories of the Massachusetts Department of Public Health, consisted of diluted diphtheria toxin (0.02 MLD per 0.1 cc. dose) and purified diphtheria toxoid (0.008 Lf per 0.1 cc. dose) for use as the biological control.

Purified diphtheria toxoid was used in the control test to eliminate pseudoreactions caused by heated diphtheria toxin when used as a control. Possibly the heating process used in destroying the diphtheria toxin so alters the other proteins present that they are no longer capable of causing the reactions of the unheated material (*9*). The amount of toxoid used in each 0.1 cc. dose, though somewhat empirical, is gen-

Dr. Atwater, formerly with the Montgomery County Health Department, is now director of the Public Health Service's Texas-Michigan Migrant Project. Dr. Peeples is deputy State and county health officer of Montgomery County, Md.

erally accepted as a more than satisfactory substitute for the heated toxin (*10*), and the intradermal skin reaction gives an index to the expected local and systemic reactions from a large dose of diphtheria toxoid.

A carefully measured 0.10 cc. of the dilute Schick toxin was injected intradermally in the left forearm, and the same amount of the control toxoid was injected into the right forearm after both surfaces had been prepared with alcohol.

For administrative reasons, the tests were read at 48 or 72 hours rather than at 96 or 120 hours as is commonly recommended when a control test is not used (*11*), and reactions were recorded in terms of actual measurement of the greatest diameter of induration at both the test and control sites. Test reactions of 10 mm. diameter or more, which were more than twice the size of the control reaction, were considered positive. To allay unnecessary anxiety, each child was given a printed interpretation of his particular reaction to the test, and the tester individually discussed the significance of each positive and allergic (control positive) reaction with the student.

While it is recognized that the use of dilute diphtheria toxin and toxoid for the testing actually gives subjects a small amount of immunizing antigen, sufficient to produce immunity in borderline susceptibles and probably cause a significant rise in antibody titer in immune subjects (*12*), it was not deemed feasible in this study to attempt to evaluate this effect.

To obtain comparable figures for older age groups, the test was also offered to, but not urged upon, the school faculty and lay personnel assisting with the testing. For each person tested the following information was obtained: name, school, sex, race, birth date, and lifelong residence in Montgomery County.

Information as to previous diphtheria immunization was not requested because of the large error in reporting to be expected from such a group as demonstrated by Geiger and associates in their San Francisco study of 1947–48 (*13*). It was further thought to be unnecessarily time consuming to seek such information from previous school medical records.

Schick Test Results

In the 9 schools with a total enrollment of 1,862 in the senior classes, 1,286 students were tested. Of these, 102, or 7.9 percent, had positive reactions (table 1). This figure is considerably lower than has been reported in similar age groups by other investigators (*14–19*). An additional 64, or 4.9 percent, had reactions of less than 10 mm., but the majority of these were of less than 4 mm. Since readings were taken at 48 or 72 hours, these probably represented local reaction to the trauma of injection rather than true mild reactions to the toxin, as there was an even greater number of similar minor reactions at the control site.

Of the 110 adults tested, 42, or 38 percent, were positive. This figure approximates those reported in naval recruits (*20, 21*), in soldiers (*10, 22*), and in medical students (*14*). All of these studies, however, dealt primarily with young adults. Sensitivity reactions were more frequent among the adults, as was to be expected, and the severity of such reactions was much greater (*14, 16*). In at least 3 instances in this study, adults with positive reactions still complained of pruritus and induration 2 months after the testing.

All students with positive Schick reactions

Table 1. Results of Schick tests, Montgomery County, Md., 1957

Participants	Negative Schick and control		Positive Schick		Negative Schick, positive control	
	Number	Percent	Number	Percent	Number	Percent
Students	908	70.6	102	7.9	276	21.5
Adults	49	44.5	42	38.2	19	17.3
Total	957	68.6	144	10.3	295	21.1

Table 2. Schick reactors by sex and race, Montgomery County, Md., 1957

Reactions	Students								Adults			
	White		Nonwhite		Female		Male		Female		Male	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Positive	96	7.8	6	9.8	46	7.0	56	8.9	23	40.3	19	35.8
Negative	1,129	92.2	55	90.2	611	93.0	573	91.1	34	59.7	34	64.2
Total	1,225	100	61	100	657	100	629	100	57	100	53	100

were referred to their private physician for immunization at his discretion. Because of increased sensitivity to diphtheria toxoid and the questioned significance of a single Schick test in an adult as an indication for toxoid administration (*14*), adults were cautioned about the possible consequences of requesting immunization and were advised to consult with their physician and to follow his advice. Approximately 2 months after completion of the testing program, a survey of all Schick positive students revealed that only 43 of 102 had contacted their doctors, and 27 of these had received immunizations. In addition, it is known that at least 7 of the adult group received toxoid.

Of 61 Negro students tested, 6, or 9.8 percent, had positive reactions. This is not significantly different from the 7.8 percent positive rate found in 1,225 white students. The reactor rate for all male students was 8.9 percent and for females 7.0 percent (table 2); however, this difference is of doubtful statistical significance.

In the adult group, the reverse was true; males 35.8 percent, females 40.3 percent. It is felt that the relatively increased immunity of the adult male over the female is due to the fact that the males tested were, in general, younger than the females.

Analyzing the reactor rates by age (table 3), a definite rise in the reactor rate with increasing age is evident. It must be recognized, however, that the spread of ages was heavily concentrated in 17- and 18-year olds, with 60 percent and 23 percent, respectively, of the total tested falling in these age groups.

The decreasing levels of immunity with increasing age, evident in this study, is the antithesis of that reported in school children in Baltimore in 1928 (*17*), and in New York in 1921 (*23*), when immunity to diphtheria was principally due to natural exposure to *C. diphtheriae* rather than having been artificially produced.

Because of the marked differences in socioeco-

Table 3. Percentage of positive Schick reactions by age and sex, Montgomery County, Md., 1957

Age	Number tested	Number positive	Percent positive	Males positive		Females positive	
				Number	Percent	Number	Percent
16	66	3	4.6	0	0	3	4.6
17	838	69	8.2	38	4.5	31	3.7
18	321	27	8.4	17	5.3	10	3.1
19	38	3	7.9	2	5.3	1	2.6
20–29	34	5	14.7	2	5.9	3	8.8
30–39	38	12	31.8	8	21.0	4	10.5
40–49	33	18	54.9	7	21.2	11	33.3
50 and over	13	7	53.8	1	7.6	6	46.1
Not listed	15	0					
All ages	1,396	144	10.3	75	10.9	69	9.6

nomic factors between urban and rural sections of Montgomery County, a higher degree of immunity was anticipated for the urban area with its greater availability of medical supervision. Actually, however, the rate of immunity in the 3 largest schools serving the urban segment of the county is insignificantly lower than that in the remaining 6 schools in the more rural areas, which included the 1 all Negro school with the highest rate of any. On the other hand, the spread between the two largest schools with apparently similar population groups was from 6.2 percent to 9.2 percent positive reactors.

To the question, "Allowing for up to 6 months absence, have you always lived in Montgomery County?" 870 students (68 percent) and 100 adults (91 percent) answered negatively. There was no significant difference between the answers of the Schick reactors (students, 65 percent; adults, 90 percent) and the nonreactors (students, 68 percent; adults, 91 percent). This indicates that the marked immigration into the county has not introduced a new susceptible group into a relatively immune population, as has been demonstrated before some epidemics (*23*).

Conclusions

The principal conclusion to be drawn from the data is that regardless of whatever minor differences in immunity levels among the students might occur on the basis of age, sex, race, length of residence, or rural-urban location, the Schick reactor rate in Montgomery County high school seniors is low. It compares quite favorably with the 23 percent reported in San Francisco (*13*), and 17 percent in York, Pa. (*8*).

The senior high school population, therefore, is quite well protected against diphtheria and the occurrence of more than sporadic cases is unlikely. The adults in the school population, on the other hand, are significantly less immune. In addition to the annual evaluation of immunization among preschool children, it might be well to sample regularly, at perhaps 5-year intervals, the diphtheria immunity of the teen-aged groups and young and middle-aged adults.

Such periodic evaluation may well evidence that since infant and preschool immunization in this particular community is accepted practice, the facilities and efforts of the health department and medical profession should be directed toward maintaining high levels of immunity in the adult population.

In considering this possibility we must remain aware of the high levels of sensitivity to diphtheria toxoid. Edsall and associates report on the use of minute amounts (1 to 2 Lf) of highly purified diphtheria toxoid in combination with tetanus toxoid (*25*). Such combination has been used by the Armed Forces for approximately 3 years and has recently become commercially available as "tetanus-diphtheria toxoid, for adult use."

It is probable that because of the low incidence of cases of diphtheria and, therefore a decreased incidence of carriers of virulent diphtheria organisms, active, natural immunization is not occurring with any great frequency. The high degree of immunity demonstrated probably represents a carryover of significant protection from preschool immunizations. Immunization in the adult population, however, when performed was done with antigens, presumably less effective than those now available, and the lack of reinforcing exposures to the organism may be of greater importance.

Summary

In January and February 1957, 1,286 Montgomery County, Md., 12th graders and 110 adults were given Schick tests with control tests. The Schick positive rate for the students was 7.9 percent and for the adults, 38 percent. No statistically significant correlation was found for race, sex, or residence.

The results suggest the need for periodic sampling of diphtheria immunity among teen-aged and adult segments of the population.

REFERENCES

(*1*) Thelander, H. E.: Diphtheria immunity and frequency distribution curves for antitoxin. Am. J. Dis. Child. 59: 342–352, February 1940.

(*2*) Jenkins, A. A.: Diphtheria epidemic in Utah in 1947. Pub. Health Rep. 63: 573–577, Apr. 30, 1948.

(*3*) Eller, C. H., and Frobisher, M., Jr.: An outbreak of diphtheria in Baltimore in 1944. Am. J. Hyg. 42: 179–188, September 1945.

(4) Koomen, J., Jr., and Cameron, C. M., Jr.: Diphtheria—A continuing North Carolina health problem. North Carolina M. J. 16: 532–536, November 1955.
(5) U. S. National Office of Vital Statistics: Communicable disease summary for week ended December 6, 1956. Washington, D. C., 1956.
(6) U. S. National Office of Vital Statistics: Provisional information on selected notifiable diseases in the United States and on deaths in selected cities for week ended December 29, 1956. Morbidity and Mortality Weekly Report, Jan. 4, 1957. Washington, D. C., 1957.
(7) Montgomery County Health Department: Summary of preschool conference 1956. Rockville, Md., 1956. Printed form.
(8) Eichelberger, E.: How long does immunity to diphtheria last? Am. J. Pub. Health 38: 1234–1238, September 1948.
(9) Cohen, P., Schneck, H., and DuBow, E.: False positive reactions to the Schick test. J. A. M. A. 142: 390–392, Feb. 11, 1950.
(10) Pappenheimer, A. M., Jr., Edsall, G., Lawrence, H. S., and Banton, H. J.: A study of reactions following administration of crude and purified diphtheria toxoid in an adult population. Am. J. Hyg. 52: 357–370, November 1950.
(11) Maryland State Department of Health: Recommended standards and procedures for routine immunization of young children. Baltimore, 1956. Printed form.
(12) Glenny, A. T., and Allen, K.: The Schick dose of diphtheria toxin as a secondary stimulus. J. Hyg. 21: 104–111 (1922–23).
(13) Geiger, J. C., Barrett, P. S., Spillane, A. L., Miller, R., and Welke, H. F.: Results of Schick and Moloney tests given 663 students in five San Francisco high schools. San Francisco Department of Public Health, 1948. Mimeographed.
(14) Goodner, K., and DeAndino, A. M., Jr.: Significance of Schick test in adults. Federation Proc. 10: 409 (1951).
(15) Edsall, G.: Medical progress: Active immunization. New England J. Med. 241: 18–26, July 7, 1949; 60–70, July 14, 1949; 99–107, July 21, 1949.
(16) Edsall, G., Banton, H. J., and Wheeler, R. E.: The antigenicity of single graded doses of purified diphtheria toxoid in man. Am. J. Hyg. 53: 283–295, May 1951.
(17) Frost, W. H.: Infection, immunity and disease in the epidemiology of diphtheria with special reference to some studies in Baltimore. J. Prev. Med. 2: 325–343 (1928).
(18) Lane, E. A., and Holla, W. A.: Diphtheria immunity in high school seniors. New York State J. Med. 49: 2548–2549, Nov. 1, 1949.
(19) James, G., Longshore, W. A., Jr., and Hendry, J. L.: Diphtheria immunization studies of students in an urban high school. Am. J. Hyg. 53: 178–201, March 1951.
(20) Cheever, F. S.: A Schick survey of 18,000 naval recruits. Am. J. Pub. Health 38: 374–377, March 1948.
(21) Altman, J. S., and Edsall, G.: Response to second Schick test in individuals remaining positive after one Schick test. Federation Proc. 10: 400 (1951).
(22) Liao, S. J.: Immunity status of military recruits in 1951 in the United States. Am. J. Hyg. 59: 262–272, May 1954.
(23) Zingher, A.: The Schick test performed on more than 150,000 children in public and parochial schools in New York. Am. J. Dis. Child. 25: 392–405 (1923).
(24) Rosenau, M. J.: Preventive medicine and hygiene. Ed. 7, edited by K. F. Maxcy. New York, N. Y., Appleton-Century-Crofts, 1951, p. 1297.
(25) Edsall, G., Altman, J. S., and Gaspar, A. J.: Combined tetanus-diphtheria immunization of adults: Use of small doses of diphtheria toxoid. Am. J. Pub. Health 44: 1537–1545, December 1954.

London Seminar in Health Education

An international seminar on the principles, methods, and media of health education was held in London, England, April 22–25, 1958, under the sponsorship of the Central Council of Health Education.

The program covered the philosophy and practice of health education through theoretical lectures, group discussions, and practical demonstration of techniques. Scheduled subjects were planning the program, choosing the methods, selecting the means, use of equipment, and mass media in health education.

Comparison of CF and HI Tests on Psittacosis-LGV Serums

MATTHEW A. BUCCA, Ph.D.

WITHIN recent years, public health laboratories have received an unprecedented number of requests for the laboratory diagnosis of specimens from patients with suspect infections incriminating members of the psittacosis-lymphogranuloma venereum (LGV) group of viruses. Since most of the laboratories are not equipped to prepare their own psittacosis antigens for the performance of complement fixation (CF) tests, it has been necessary to rely upon commercially available sources for their supply. It has also been the practice, and at times the necessity, to substitute LGV for psittacosis CF antigens in tests on serums from cases of psittacosis on the basis that one is dealing with a group-specific antigen-antibody reaction. Meyer (*1*) stated that half of his serums positive by psittacosis CF test exhibited no reaction with lygranum antigen dosages indicated on the label. Volkert and Christensen (*2*), however, concluded from their data that both antigens in two unit dosages may be utilized for routine testing. The present study represents a comparison of three tests using psittacosis and LGV antigens on individual human serums.

Methods

The psittacosis antigen (*3*) consisted of heavily infected allantoic fluids which were phenolized and subsequently lyophilized after concentration to one-fifth the original volume. Control antigen was prepared in the identical manner using normal embryonated eggs of the same age and batch.

Lygranum CF antigen was purchased from commercial sources, and the control antigen was the one accompanying the viral antigen.

The CF test for this study was that described by Sigel and co-workers (*4*). Both psittacosis and lygranum CF antigens were titrated by the block technique with ornithosis positive serum and two units used in the respective tests. Complement was added to the antigen-antibody system in a dosage of 1.8 to 2.0 units. All test serums were preliminarily absorbed with packed sheep erythrocytes and then inactivated at 56° C. for a period of 30 minutes before testing.

The psittacosis hemagglutinating antigen was also prepared from infected embryonated eggs. The infected allantoic fluid was centrifuged at 5,000 × gravity for 1 hour and the supernatant fluid, which served as the hemagglutinin, was stored at temperatures below −30° C. The hemagglutination-inhibition (HI) test was performed according to the method of Hilleman and co-workers (*5, 6*). All serums for this test were first absorbed with murine erythrocytes and then inactivated at 56° C. for 30 minutes.

Results

One hundred and six "negative" serums were selected to ascertain the baseline reaction of the HI test. Selections were based on a series of preliminary tests performed on serums received in the laboratory showing negative CF reactions in dilutions of 1:2 when tested with psittacosis

Dr. Bucca is chief, Viral and Rickettsial Reagents Unit, Diagnostic Reagents Section, Laboratory Branch, Communicable Disease Center, Chamblee, Ga. The work was performed at the Virus and Rickettsia Section, Montgomery, Ala.

Table 1. Nonspecific inhibition of serums by psittacosis HI test

Serum dilution	Number	Percent
<1:16	30	28.3
1:16	64	60.3
1:32	12	11.5
1:64	0	0

and lygranum CF antigens. These serums were also found to be negative by CF tests for certain members of the neurotropic group of viruses routinely tested in the diagnostic laboratory.

It may be seen from table 1 that nonspecific inhibition may occur in this test in serum dilutions through 1:32. Most of the hemagglutinin inhibitions appeared in serum dilutions of 1:16. A serum dilution of 1:64 must, therefore, be used for the baseline reactivity to avoid nonspecificity.

A total of 103 positive serums were tested for the comparative test series. Most of these serums (87 percent) were taken from patients presenting a clinical history of, or exposure to, members of the psittacosis-LGV group of viruses (ornithosis and lymphogranuloma venereum). The results of the three serologic tests performed on the same serums are shown in tables 2, 3, and 4.

It is apparent from table 2 that psittacosis CF antigen was able to detect a larger number of positive serums than lygranum CF antigen. Ten of the serums (9.7 percent) showed some positive titer with psittacosis CF antigen when lygranum CF antigen was unable to react at the lowest dilution of serum tested (1:2). Thirty-six (34.9 percent) of the serums elicited the same titer when tested with both CF antigens. Higher titers with psittacosis CF antigen were obtained with 61.2 percent of the serums as compared with lygranum CF antigen tested on the same serums, whereas only 3.9 percent of the serums gave higher titers with lygranum antigen.

Table 2. Number of serums reacting to psittacosis and lygranum CF tests

Psittacosis CF Titers	Lygranum CF Titers										
Serum dilution	<1:2	1:2	1:4	1:8	1:16	1:32	1:64	1:128	1:256	1:512	Total
1:2	4	9	1								14
1:4	3	12	8	2							25
1:8		3	10	6							19
1:16	1			10	8						19
1:32	1	1		2	7	4					15
1:64	1				2	6					9
1:128								1			1
1:256										1	1
Total	10	25	19	20	17	10	0	1	0	1	103

Table 3. Number of serums reacting to psittacosis CF and psittacosis HI tests

Psittacosis CF Titers	Psittacosis HI Titers								
Serum dilution	<1:16	1:16	1:32	1:64	1:128	1:256	1:512	1:1,024	Total
1:2	1	10	3						14
1:4	1	11	5	6	2				25
1:8		5	4	5	3	2			19
1:16			2	3	10	4			19
1:32			1	5	6	1	2		15
1:64				1	2	4	1	1	9
1:128								1	1
1:256							1		1
Total	2	26	15	20	23	11	4	2	103

Table 4. Number of serums reacting to psittacosis HI and lygranum CF tests

Lygranum CF Titers	Psittacosis HI Titers								
Serum dilution	<1:16	1:16	1:32	1:64	1:128	1:256	1:512	1:1,024	Total
<1:2		3	2	1	2	1	1		10
1:2	2	14	6	2		1			25
1:4		7	4	4	3	1			19
1:8		2	1	7	8	2			20
1:16			2	5	6	3	1		17
1:32				1	4	3	1	1	10
1:64									0
1:128								1	1
1:256									0
1:512							1		1
Total	2	26	15	20	23	11	4	2	103

From tables 3 and 4 one observes that an equal number of serums (60) showed positive HI titers (considering the baseline titer of the HI test to be 1:64 or higher) from both the psittacosis CF and lygranum CF groups. Five of the serums (4.9 percent) exhibiting no reaction with lygranum CF antigen in dilutions of 1:2 or higher elicited HI titers of 1:64 through 1:512. More serums (33 percent) tested with lygranum CF antigen in low dilutions (up through 1:8 dilution of serum) gave positive HI titers than serums tested with psittacosis CF antigen (18 percent) in the same dilution range. Of the 93 serums which were positive by both psittacosis CF and lygranum CF tests, only 55 (or 59.1 percent) were positive to the psittacosis HI test.

Discussion

The results presented above indicate that a nonspecific reaction may be obtained in the psittacosis HI test in serum dilutions through 1:32. At a serum dilution of 1:32, 11.5 percent of the 106 serums tested showed this type of reaction. Hilleman and co-workers (*5*) have indicated from a smaller group study that human serum titers of less than 1:40 are not considered significant when tested with meningopneumonitis hemagglutinating antigen. Studies conducted by Ephrati-Elizur and Bernkopf (*7*) show that 6 percent of their apparently normal serums reacted nonspecifically in dilutions of 1:40 and 2 percent in dilutions of 1:80. They, therefore, considered HI titers above 1:80 as falling outside of the normal range of nonspecificity. It should, however, be pointed out that this unfavorable property of the HI test may not necessarily invalidate the application of this test to diagnostic procedures. The serologic criterion of an infection is generally taken as a fourfold or higher increase in titer of the convalescent phase serum over the acute phase specimen. Although individual serums elicit considerable variations in the nonspecific property, the demonstration of a rise in HI antibody with paired serums may provide significant diagnostic information.

Meyer and Eddie (*8*) state that LGV antigens from any source are unsatisfactory for the serodiagnosis of psittacosis infections and that only psittacosis antigens should be utilized in the CF test. A large number of our reactive serums were derived from patients with clinical histories indicating infections of the psittacosis-LGV group or presenting a history of exposure to birds. Our results verify the fact that the psittacosis antigen generally exhibits a higher sensitivity than the lygranum antigen in serums with positive psittacosis CF tests.

Summary and Conclusion

Three tests were compared for the detection of antibodies to the psittacosis-LGV group of viruses.

The psittacosis HI test exhibits nonspecific reactions in serum dilutions through 1:32. This places a limitation on its practical application except where a significant antibody rise in paired serums can be demonstrated.

Only 59 percent of the serums positive by both psittacosis CF and lygranum CF tests were also positive by the psittacosis HI test.

With the current techniques employed, the psittacosis CF antigen reacts with a larger number of serums and in general gives higher titers than the lygranum CF antigen.

REFERENCES

(1) Meyer, K. F.: Early diagnosis of infections by the psittacosis-lymphogranuloma venereum group. *In* The dynamics of virus and rickettsial infections, edited by F. W. Hartman, F. L. Horsfall, and J. G. Kidd. New York, Blakiston Co., Inc., 1954, ch. 23, pp. 295–323.

(2) Volkert, M., and Christensen, P. M.: Studies on ornithosis in Denmark. Acta path. et microbiol. Scandinav. 35: 584–590 (1954).

(3) Whitney, E., and Gnesh, G. M.: Potent psittacosis antigens free of anticomplementary activity. Proc. Soc. Exper. Biol. & Med. 87: 356–360 (1954).

(4) Sigel, M. M., Allen, E. G., Williams, D. J., and Girardi, A. J.: Immunologic response of hamsters to influenza virus strains. Proc. Soc. Exper. Biol. & Med. 72: 507–510 (1949).

(5) Hilleman, M. R., Haig, D. A., and Helmold, R. J.: The indirect complement fixation, hemagglutination and conglutinating complement absorption tests for viruses of the psittacosis-lymphogranuloma venereum group. J. Immunol. 66: 115–130 (1951).

(6) Hilleman, M. R., Haig, D. A., and Helmold, R. J.: In vivo and in vitro studies of serological specificity among viruses of the psittacosis-lymphogranuloma venereum group, J. Immunol. 68: 121–129 (1952).

(7) Ephrati-Elizur, E., and Bernkopf, H.: Isolation of six strains of ornithosis virus from children with infections of the respiratory tract. J. Infect. Dis. 98: 45–51 (1956).

(8) Meyer, K. F., and Eddie, B.: Psittacosis. *In* Diagnostic procedures for virus and rickettsial diseases, edited by T. Francis, Jr. New York, American Public Health Association, 1956, pp. 339–430.

Local Health Departments and Rehabilitation

Local health departments with trained and experienced staff would be immensely helpful in all areas of service to the handicapped, according to the conclusions of a 1956–57 study of rehabilitation services for the deaf and hard of hearing in Metropolitan Boston. The study was conducted by the Rehabilitation Council, United Community Services of Metropolitan Boston.

Lack of adequate local public health services is basic to many of the problems of availability and use of rehabilitation services, the council concluded. They mentioned these problems in particular: hearing testing in parochial schools, followup of screening test failures, development of ancillary services in suburban and rural areas, and adequate speech reading and auditory training facilities in public schools.

Many of the findings of their study, the council pointed out, are applicable to all the handicapped.

Variation in Three Staphylococcal Typing Phages

JOHN E. BLAIR, Ph.D.,
and E. T. BYNOE, Ph.D.

A standard set of staphylococcal typing phages is now used in practically all laboratories where a staphylococcal typing service has been established. Comparison of the phage patterns encountered in different laboratories is valid only to the extent that the phages used in those laboratories have remained stable and have retained their original patterns of lytic activity. This is especially important when one attempts to determine the geographic distribution of strains of *Staphylococcus aureus* showing a specific phage pattern. It is conceivable that although the same strain might be encountered in several different laboratories, it would not be regarded by some laboratories as being identical if variation had affected the lytic patterns of the phages concerned.

That variation in patterns of lytic activity may occur was demonstrated by Wahl (*1*), who noted that from phage 44A, which has a rather limited lytic spectrum, a mutant phage developed which exhibited a wide range of activity. The mutant was designated as "phage 68."

We have obtained evidence which suggests that variation in lytic activity has taken place in certain staphylococcal typing phages that are currently being used in the United States. The phages involved are those designated as "52," "42B," and "44A."

Dr. Blair is head of the division of bacteriology, laboratories division, Hospital for Joint Diseases, New York City, and Dr. Bynoe is chief of the bacteriology laboratories, laboratory of hygiene, Department of Health and Welfare, Ottawa, Canada. They represent the United States and Canada on the International Committee on Staphylococcus Phage Typing, and their laboratories are the central reference laboratories for staphylococcal phage typing in their respective countries.

Phage 44A appears to have undergone variation in the direction of a wide host range, in a manner comparable to that observed by Wahl. It often occurs in the phage pattern of strains of staphylococci in any of the broad phage groups, and thus appears to be of little differential value.

Soon after the report by Bynoe, Elder, and Comtois (*2*) of the existence of a strain of *S. aureus* which was susceptible only to the recently described phage 81, it was found that apparently similar strains isolated in the United States were lysed by phages 52 and 42B as well as by phage 81. We suspected that this could probably be attributed to the fact that the phages 52 and 42B employed in laboratories in the United States had undergone some variation in lytic activity in the direction of a slightly wider host range. In most instances these phages had been supplied by Dr. Blair.

To determine whether variation in lytic activity had occurred, we examined a number of strains of *S. aureus*, isolated both in Canada and the United States, which were known to be susceptible to phage 81. The stock phages and propagating strains of our laboratories were exchanged and the following preparations were made in each laboratory: Laboratory of Hygiene ("LH") phages were propagated on LH strains of *S. aureus;* LH phages were prepared on Hospital for Joint Diseases (HJD) strains; HJD phages were propagated on LH strains; and HJD phages were prepared on HJD strains. The cultures to be examined were then typed in the usual manner with each of the four phage preparations.

The results obtained in both laboratories showed essentially mutual confirmation. Canadian strains of *S. aureus* that had been lysed only by the LH stock phage 81 showed only the pattern 81 when typed with LH phages prepared on either LH or HJD propagating strains. When typed with HJD phages prepared on either LH or HJD propagating strains, they showed the pattern 52/42B/81. Strains isolated in the United States that had originally shown the pattern 52/42B/81 with the HJD stock phages were lysed only by phage 81 when typed with LH phages prepared on either LH or HJD propagating strains. When typed with HJD phages prepared on LH or

HJD propagating strains, these strains showed the pattern 52/42B/81.

It seems clear that phages 52 and 42B, as maintained in the laboratory of the Hospital for Joint Diseases, had undergone variation to the extent that they were able to lyse cultures of "type" 81. Variation apparently has not gone beyond this point, for both phage 52 and phage 42B have appeared only in other patterns in which they might normally be expected to occur.

The cultures, stock phages, and propagating strains from both laboratories were submitted to Dr. R. E. O. Williams in the Central Reference Laboratory in London, who examined them in a manner similar to that described above and in a personal communication reported confirmation of our results.

Bynoe and his associates have reported that phage 80, which was developed in Australia by Rountree and Freeman (*3*), appears to be closely similar to phage 81, and that cultures of *S. aureus* which are susceptible to phage 81, are nearly always lysed also by phage 80 (*2*). This has been the experience in the laboratory of the Hospital for Joint Diseases.

There would appear to be little question that the strains of *S. aureus* which now are being widely encountered in Canada and the United States and which have been reported, respectively, to show the patterns 81 or 52/42B/81 are identical. In the interest of uniformity of reporting and to remove any confusion that might exist in the minds of the readers of the literature as to the identity of these strains, the authors propose that such strains now be designated as 80/81, the designation given them by the International Typing Reference Center at the Central Reference Laboratory.

To insure results that are more nearly comparable to those obtained at the Central Reference Laboratory, Dr. Blair has obtained from Dr. Williams new specific lots of phages 52, 42B, and 44A, which he plans to include in sets of phages for future distribution and to send to those laboratories in the United States where a phage typing service is now in operation.

REFERENCES

(*1*) Wahl, R., and Lapeyre-Mensignac, P.: L'identification des staphylocoques par les bacteriophages. II. Essai de classification des staphylocoques par la methode des phages. Ann. Inst. Pasteur 78: 765–777 (1950).

(*2*) Bynoe, E. T., Elder, R. H., and Comtois, R. D.: Phage-typing and antibiotic-resistance of staphylococci isolated in a general hospital. Canad. J. Microbiol. 2: 346–358 (1956).

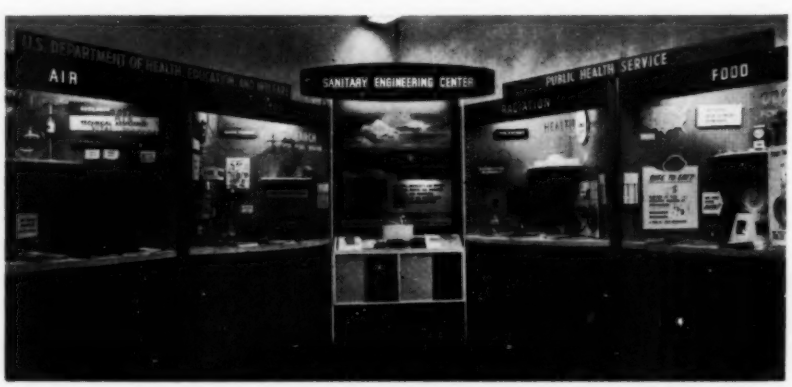
(*3*) Rountree, P. M., and Freeman, B. M.: Infections caused by a particular phage type of *Staphylococcus aureus*. Med. J. Australia 42: 157–161 (1955).

PHS Exhibit

Sanitary Engineering Center Program

An exhibit of the Robert A. Taft Sanitary Engineering Center of the Public Health Service shows major programs of environmental research. The central panel is flanked by four others, for air, water, radiation, and food, respectively.

The displays include animated and still graphics, models, samples, literature, and some equipment in operation.



Specifications: Floor space 20′ by 8′. (Can be used with different arrangements of the five units.) Operates from one or two 110-volt a. c. outlets. Shipping weight, 1,200 lbs. The setting-up requires two men. Available by special arrangement only with the Director, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati 26, Ohio.

Poverty, Pica, and Poisoning

J. EDMUND BRADLEY, M.D., and SAMUEL P. BESSMAN, M.D.

A RECENT study of 333 children living in an old, congested, low-income area of Baltimore, Md., showed that 44.4 percent of these children had abnormal blood lead values of 0.05 mg. percent and higher (*1*). The children were selected at random from those brought to the pediatric clinics of the University of Maryland Hospital for health supervision or for complaints other than those usually associated with lead poisoning.

Since the history of pica (eating of nonfood material) was found in 69.6 percent of the children, the source of lead apparently was paint chewed from surfaces of wood or plaster or particles of paint swallowed after it had flaked from the surfaces.

Samples of paint were collected from typical homes and the lead content determined. The lead content in each sample was in excess of the recommended 1 percent of the total weight of the contained solids (*2*).

The majority of the children apparently swallowed paint from indoor surfaces. However, others may have eaten paint which had peeled from exterior walls. The interior of the home of one child with lead poisoning did not have toxic amounts of lead on its painted surfaces, but it was learned that the child sat on the stoop outside and ate particles of paint fallen from the exterior walls. These contained toxic amounts of lead.

Dr. Bradley is professor and head of pediatrics, and Dr. Bessman is associate professor of pediatrics, University of Maryland School of Medicine. *A grant-in-aid from the Department of Health, Education, and Welfare supported the study described in this article.*

Pica as the source of lead was also supported by the lack of abnormal blood lead values in infants under 10 months of age. However, the increased incidence of abnormal values beginning at 10 months of age continued through the third year of life and then declined. This age distribution corresponds to the period when the child is confined to the home, has greater need for oral gratification, and in crowded situations has fewer controlled interest opportunities. Further support for pica as the source of lead intoxication is found in current studies by Dr. J. E. Bradley and R. S. Mosser of blood lead values of children in different socioeconomic strata. The data obtained suggest that the mean values of the lower group will exceed many fold the mean values of the middle and upper groups.

Contributing factors to this high incidence of lead intoxication seems to be related directly to environment. First, these children live in houses where lead-containing paint, used many years ago, is now flaking and peeling from the surface. Second, there seems to be widespread ignorance or disregard of the hazards to the child through the ingestion of these particles. Despite vigorous education campaigns which have been conducted by the public health department in Baltimore, many parents continue to accept pica as a harmless manifestation of normal infantile development. Third, crowded conditions within the home, and in many instances the absence of supervision by adults who may be obliged to leave the children to earn a living, allow the infant and preschool child opportunity to eat toxic material without restraint.

The main hazard of lead poisoning in a child

is lead encephalopathy. The frequency of lead encephalopathy is unknown, since only a few communities require reports of these cases. The incidence is suggested from the report that 538 Baltimore children were admitted to Baltimore hospitals with lead encephalopathy from January 1, 1931, to January 1, 1956 (*3*). Lead encephalopathy, despite recent advances in treatment, continues to result in neurological sequela, mental retardation, or death (*4,5*).

The observations in the Baltimore study suggest that there is a high incidence of lead poisoning in other metropolitan areas where slums exist and where paint contains lead. The study also suggests that physicians need to be constantly aware and alert to the symptoms of lead poisoning in children.

Since this disease is essentially environmental, preventive measures are possible. This will require the cooperative effort of physicians, nurses, and social workers of municipal health and welfare departments who will warn parents constantly of the seriousness of pica in children.

REFERENCES

(*1*) Bradley, J. E., Powell, A. E., Niermann, W., McGrady, K. R., and Kaplan, E.: The incidence of abnormal blood levels of lead in a metropolitan pediatric clinic. J. Pediat. 49: 1–6 (1956).

(*2*) American Standards Association: American standard specifications to minimize hazards to children from residual surface coating materials. ASA Standard Z66.1. New York, 1955, p. 1.

(*3*) A new health department committee on the prevention of lead poisoning. Baltimore Health News 33: 80–81 (1956).

(*4*) Bessman, S. P., Rubin, M., and Leikin, S.: The treatment of lead encephalopathy; a method for the removal of lead during the acute stage. Pediatrics 3: 201–208 (1954).

(*5*) Bradley, J. E., and Menon, G.: A comparison of Dimercaprol (BAL) and CaEDTA in the treatment of lead encephalopathy. Am. J. Dis. Child. 92: 479–481 (1956).

Legal Criteria for Evidence of Intoxication

A bill setting forth the legal significance of findings from alcoholic intoxication tests of drivers on trial in the District of Columbia became law March 4, 1958. The legislation eliminates a previous need for expert witnesses to explain the legal ramifications of test results.

If the defendant's blood has 0.15 percent or more alcohol by weight, or an equivalent proportion of alcohol in 2,000 cubic centimeters of his breath, he is presumed to be intoxicated. Alcohol equaling 0.20 percent by weight in the urine has the same legal significance.

Percentages of 0.05 or less in the blood or breath and 0.08 or less in the urine are proof of sobriety; and alcohol levels between 0.05 and 0.15 in the blood and breath and between 0.08 and 0.20 in the urine constitute relevant evidence but neither proof nor disproof of sobriety or intoxication.

Drivers are not obligated to submit to the tests, the results of which apply when they are tried for driving while intoxicated, for negligent homicide, or for manslaughter.

Only a physician acting at the request of a police officer may withdraw a blood sample for testing. The defendant may request that his own physician conduct additional chemical tests. Results are available to the tested person on request.

Rat, Flea, and Murine Typhus Recurrence Following Eradication Measures

WILLIAM W. SMITH, Ph.D.

AN EXPERIMENTAL attempt to eradicate murine typhus was made in the rural southeastern quarter of Grady County, Ga., between July 3, 1953, and May 4, 1954. The experiment was considered a success and has been reported by Mohr and Smith (*1*).

The chief eradication measures used were intensive poisoning of commensal roof and Norway rats, *Rattus rattus* (Linnaeus) and *Rattus norvegicus* (Erxleben), and applying 10 percent DDT dust in rat runs to reduce the numbers of oriental rat fleas, *Xenopsylla cheopis* (Rothschild). Though lack of time for extensive studies and application of special treatments made it impossible to eliminate rats completely at about 5 percent of the farms in the experimental area, it was believed that eradication of murine typhus would not require complete elimination of rats and oriental rat fleas.

For 3 years after the eradication program, the experimental area was inspected periodically to determine the rates at which commensal rats, rat fleas, and murine typhus reestablish themselves. The results of these inspections are reported here.

Methods and Procedure

During the period July 13 to August 5, 1954, a preliminary inspection was made of 306 premises closest to the 5.5 percent from which it had not been possible to eradicate all rats. More extensive inspections were made annually during the months of March through May in 1955, 1956, and 1957. It was not possible each year to inspect every one of the premises originally inspected and grouped according to infestation status under the eradication program. Each annual inspection, however, covered a representative number of premises in each of the three groups that had been set up under the eradication program (table 1).

The farm premises were examined for signs of rats such as fresh droppings, burrows, trails, and gnawing. Occupants were questioned as to whether or not rats were present. If there was doubt as to the existence of an infestation, dust patches were used and the premises were reinspected until a definite decision could be reached.

Unbaited No. 0 steel traps were set in runs wherever it appeared that rats might be caught. Rats obtained alive were brought to the laboratory where they were identified, sexed, killed by bleeding from the heart, and brushed and searched for ectoparasites. Blood serums from these rats were sent to the Communicable Disease Center Virus and Rickettsia Disease Laboratory in Montgomery, Ala., where they were tested by complement fixation for the presence of murine typhus antibodies. Rats found dead in the traps were identified and recorded, but they are excluded from discussion and data presented in this paper.

Dr. Smith was, until recently, an entomologist with the Communicable Disease Center, Public Health Service, at the Newton Field Station, Newton, Ga. He is now assistant professor of entomology and assistant director of pest control at the University of Florida, Gainesville.

Although eradication measures were employed until May 4, 1954, many premises had been cleared of rats before that date. For purposes of discussion, the 1955, 1956, and 1957 inspections are considered to have been completed, respectively, 1, 2, and 3 years after the eradication program ended.

Rat Reinfestations

The preliminary inspections made in the summer of 1954 showed that 16 (5.2 percent) of the premises nearest the farms at which it had not been possible to eliminate rats had become infested again. Practically all of the 306 premises inspected at that time were within three-fourths of a mile of such farms.

The results of the last three annual inspections are shown in table 1. Of the premises cleared of rats under the eradication program and inspected each year, 70.6 percent remained uninfested at the end of the first year (1955), 67 percent at the end of the second year, and 58.3 percent at the end of the third year. In 1955, 25.4 percent of the premises inspected again had rats, and another 4 percent had become infested but were clear of rats at this inspection. In 1956, 17.2 percent of the premises inspected were reinfested, while 15.8 percent had had rat infestations since the end of the eradication program but were uninfested at the time of inspection. Inspection in 1957 showed 29.9 percent reinfested, and another 11.8 percent which had been reinfested since 1954 but were clear at this inspection.

Table 1. Commensal rat infestation of experimental area, Grady County, Ga., 1, 2, and 3 years after eradication program ending May 4, 1954

Infestation status on May 4, 1954, and subsequent changes	1955	1956	1957
Premises cleared of rats by eradication [1]			
Number inspected	221	221	198
Percent:			
Still clear	70.6	67.0	58.3
Infested	25.4	17.2	29.9
Had become infested, but clear at annual inspection	4.0	15.8	11.8
Premises uninfested at time of eradication [2]			
Number inspected	282	282	266
Percent:			
Still clear	91.5	89.4	85.5
Infested	6.7	3.5	6.7
Had become infested, but clear at annual inspection	1.8	7.1	7.8
Premises not cleared of rats by eradication [3]			
Number inspected	29	29	29
Percent:			
Still infested	44.8	24.1	21.4
Clear	55.2	72.4	46.4
Had been clear, but reinfested at annual inspection	0	3.5	32.2

[1] 232 premises.
[2] 297 premises.
[3] 31 premises.

Table 2. Incidence of typhus antibodies among commensal rats trapped in eradication area, Grady County, Ga., 1954–57

	1954	1955	1956	1957
Number of farms where rats were trapped	28	57	41	66
Number of rats:				
Trapped and examined	70	139	142	148
With typhus antibodies	3	1	4	0
Percent of rats with typhus antibodies	4.3	0.7	2.9	0.0

Premises uninfested at the time of eradication changed little from year to year, as shown by the high proportion of these premises which remained clear over the 3-year period—91.5 percent of those inspected in 1955, 89.4 percent in 1956, and 85.5 percent in 1957 (table 1).

The greatest changes of infestation status occurred in the small group of infested premises which had not been cleared of rats by eradication efforts. In 1955, 55.2 percent of the premises inspected in this group were uninfested at the time of inspection. By 1956, the percentage of premises inspected that had been clear of rats at some time since 1954 had changed to 75.9, and by 1957, to 78.6.

Typhus Antibodies in Rats

Tests of serums from 70 rats trapped immediately after eradication at 28 uncleared prem-

ises showed that 3 rats had typhus antibodies (table 2). These 3 rats came from 2 premises well within the study area. At the end of the first year after eradication, only 1 rat with typhus antibodies was found among the 139 rats trapped from 57 premises. This rat was taken from a farm at the edge of the eradication zone and was believed to have moved in from the adjacent untreated region. At the end of the second year, 4 of 142 rats taken from 41 farms showed typhus antibodies. These 4 rats came from 2 farms, one of which was near the border and the other well within the eradication area. At the end of the third year, none of the 148 rats trapped from 66 farms revealed any typhus antibodies.

Ectoparasite Abundance

Data on ectoparasite infestations of the rats examined from 1954 through 1957 are shown in table 3. In 1955, 1956, and 1957, the percentages of rats examined which were infested with *X. cheopis* were 0.0, 8.5, and 4.1, respectively. *X. cheopis* indexes (average per rat examined) were 0.0, 0.2, and 0.4 for those years. In the same years, the sticktite flea (*Echidnophaga gallinacea*) was the most abundant flea species, with averages of 6, 7.4, and 3.9 per rat examined. The most common mite was *Bdellonyssus bacoti* with annual averages per rat of 7.8, 1.1, and 2.3. The spined rat louse (*Polyplax spinulosa*) was found on 57.5, 62, and 83.2 percent of the rats examined in these years; its annual indexes were 7.2, 6.8, and 9.9, respectively.

Table 3. Ectoparasite infestation of commensal rats in eradication area of Grady County, Ga., 1954–57

Year and ectoparasite species	Ectoparasite concentration		
	Average per rat examined[1]	Percent of rats infested	Average per rat infested
1954			
Xenopsylla cheopis	0.0	0.0	0.0
Echidnophaga gallinacea	3.1	35.3	8.8
Bdellonyssus bacoti	.2	2.9	2.7
Polyplax spinulosa	1.5	17.6	6.9
1955			
Xenopsylla cheopis	0	0	0
Echidnophaga gallinacea	6.0	26.6	22.7
Bdellonyssus bacoti	7.8	19.4	40.5
Polyplax spinulosa	7.2	57.5	12.5
1956			
Xenopsylla cheopis	.2	8.5	1.9
Echidnophaga gallinacea	7.4	32.5	21.0
Bdellonyssus bacoti	1.1	12.7	8.3
Polyplax spinulosa	6.8	62.0	11.0
1957			
Xenopsylla cheopis	.4	4.1	8.9
Echidnophaga gallinacea	3.9	27.0	14.5
Bdellonyssus bacoti	2.3	18.3	12.9
Polyplax spinulosa	9.9	83.2	11.9

[1] Numbers of rats examined for ectoparasites in the years 1954–57 were 34, 139, 142, and 148, respectively, and are identical with numbers of rats trapped each year except for 1954, when 70 rats were trapped (table 2).

Discussion

Two to three months after typhus eradication measures were terminated, about 5 percent of the farm premises which had been cleared of rats during the operational period had become reinfested. All were within 1 mile of rat-infested farms. This relatively high rate of reinfestation, including those premises that had become infested but were clear at annual inspection, increased to 29.4 percent, 33 percent, and 41.7 percent of premises inspected in 1955, 1956, and 1957, respectively (table 1). The reinfestation rate was undoubtedly influenced greatly by the proximity of premises susceptible to rat infestation to those where some rats remained. Emlen and others (*2*) found that populations of Norway rats in urban situations recovered at the rate of 2 to 6 percent per month when reduced to as low as 10 percent of their original level.

Reinfestation of cleared premises, again including those that had become infested but were clear at annual inspection, increased very little (by 3.6 percent of premises inspected) between the 1955 and 1956 inspections. Possibly the increase in reinfestation was small in the second year because the emigrant rats were reestablishing colonies in the new situations and had not increased in numbers sufficiently to supply impetus for further extensive emigrations. In the third year, however, reinfestation increased by 8.7 percent (table 1). Emlen and his co-work-

ers (*2*) noted in their study that 2 years elapsed before reinfestation occurred in one location where all Norway rats had been destroyed.

Since only one survey of the study area could be made each year, progressive emigrations and reinfestations could be determined only in a general manner. Few premises which were reinfested during the first year were as far as a mile from one of the premises not entirely cleared of rats. The manner and causes of rat migration to new premises were not determined, but in addition to the ecological factors, such as dwindling food supplies and harborage removal, commonly believed to motivate emigrations, inherent wandering tendencies—particularly in roof rats—appear to be influential.

Rural premises which are uninfested by commensal rats are generally incapable of supporting or harboring these rodents. If the farm is a poor one, little or no foodstuff is likely to be available to rats, and the usual small, openly constructed buildings do not afford suitable harborage. Another deterrent is activity constant enough to disturb rats attempting to settle. In the eradication area, rat control measures on farms were rarely extensive enough to prevent reinfestation. In a few cases, however, the intensive efforts of individual farmers apparently accounted for complete freedom from commensal rats, at least for short periods. For these varying reasons, uninfested premises tended to remain uninfested (table 1).

Farms at which rat eradication was impossible were least stable with relation to changes in rat infestation. At the end of each of the 3 years after eradication measures ceased, 55.2 percent, then 75.9 percent, and finally 78.6 percent of inspected premises were free of rats. Smith (*3*) recorded a natural decline of approximately 65 percent in farm premises infested with commensal rats in neighboring Thomas County, Ga., over the past decade. In addition to the natural environmental factors which would account for part of the decrease in the number of rat-infested farms within the eradication area, it is believed that certain other factors stemming from the typhus eradication program also were contributory. These factors are: (*a*) individual actions resulting from the creation of desire in the farmer to get rid of rats, and (*b*) the program's reduction of the number of rats to the point where differences in age and sex composition prohibited reproduction of those remaining. The latter factor was believed by Emlen and his colleagues (*2*) to be responsible for the very slow recovery of Norway rat populations which had been reduced to a few individuals.

Complement fixation tests of rat blood serums indicated that antibodies to murine typhus had disappeared from the rats in the eradication area by the end of the first year, although one rat with typhus antibodies was taken at the border adjoining a known typhus-infected premise. Three of the four rats with typhus antibodies trapped at the end of the second year (1956) came from a farm in the heart of the eradication area. This farm had had a roof rat infestation which eradication measures had failed to dislodge. One of the three rats with antibodies taken from this farm was a Norway rat, indicating the possible reintroduction of typhus infection from an outside source. At the end of the next year, no evidence of rat infestation could be found at this farm, possibly because of poisoning attempts by the owner. The fourth rat with typhus antibodies (1956) was trapped at a farm near the southern edge of the experimental region. It had probably emigrated from outside the zone since several other rats taken from the same farm had no antibodies to murine typhus. The supposition that typhus was not being transmitted from rat to rat in the experimental area was further strengthened by the absence of any evidence of previous typhus infection in the rats trapped at the end of the third and final year.

A recently published paper by Smith (*4*) comparing seasonal prevalence of typhus antibodies in rats with seasonal occurrence of important commensal rat ectoparasites indicates the importance of the oriental rat flea, *X. cheopis*, as the natural vector of murine typhus among rats and the relative unimportance of other common ectoparasites. Prior experience has shown that an average of at least 1 *X. cheopis* per rat trapped usually accompanies successful transmission of typhus from rat to man. No such estimate has been postulated for rat-to-rat transmission, but the averages of 0.2 and 0.4 *X. cheopis* per rat trapped in the experimental area at the end of 2 and 3 years follow-

ing eradication indicate the practical elimination from the area of the hazard to humans of typhus transmission from rats. Although the oriental rat flea and the tropical rat mite infested more rats at the end of the second year than at the end of the first or third years (table 3), this may have been due to weather conditions toward the end of the second year which favored these ectoparasites. In fact, no case of murine typhus in humans is known to have occurred in the typhus eradication area of Grady County since the cessation of eradication measures on May 4, 1954.

Summary

During a 10-month operational period, an attempt was made to eradicate murine typhus fever from the rural endemic foci in the southeastern quarter of Grady County, Ga. Intensive rat poisoning and applications of 10 percent DDT dust to rat-infested farm premises were the chief eradication measures used.

Four extensive inspections were made within the area after eradication measures ceased on May 4, 1954. A preliminary inspection made within 2 months after the eradiction program ended indicated reinfestation of 5.2 percent of the farms nearest to those where rats were not completely eradicated. More complete inspections of the farms in the eradication area at intervals of 1, 2, and 3 years after eradication showed that rats had reinfested 29.4, 33, and 41.7 percent of the farms from which rats had been cleared.

Typhus antibodies were found in 3 of 70 rats trapped in the area immediately after the eradication program. At the end of 1 year, the 1 rat with typhus antibodies among 139 rats trapped was believed to have emigrated from adjoining untreated territory. Four rats of a total of 142 trapped at the end of the second year had antibodies to typhus, while none of 148 rats taken at the end of the third year revealed typhus antibodies. No human cases of murine typhus are known to have occurred in the experimental area since the cessation of operational procedures on May 4, 1954.

REFERENCES

(1) Mohr, C. O., and Smith, W. W.: Eradication of murine typhus in a rural area. Preliminary report. WHO Bull. 16: 255–266 (1957).

(2) Emlen, J. T., Stokes, A. W., and Winsor, C. P.: The rate of recovery of decimated populations of brown rats in nature. Ecology 29: 133–145 (1948).

(3) Smith, W. W.: Factors influencing the decline in commensal rat infestations in a rural area of southwestern Georgia. J. Mammalogy 38: 270–271 (1957).

(4) Smith, W. W.: Populations of the most abundant ectoparasites as related to prevalence of typhus antibodies of farm rats in an endemic murine typhus region. Am. J. Trop. Med. & Hyg. 6: 581–589 (1957).

Studies on Radiation Hazards Scheduled

A new program to study the hazards of radiation will be initiated in 1958 at the New York University-Bellevue Medical Center through a $500,000 grant from the Rockefeller Foundation.

According to Dr. Norton Nelson, director of the Center's Institute of Industrial Medicine, who will direct the activities of the program, attention will be given to radiation hazards for the general population as well as to special risks in industrial use.

publications

Domestic Agricultural Migrants in the United States (map and table)

PHS Publication No. 540. 1957. 25 cents.

Prepared as a basis for planning health services, the map indicates the peak demand in 902 counties which were estimated to have 100 or more migrant workers from outside the county at the peak of the normal crop season. The table gives the population of these counties and the estimated number of migrants needed by each.

The basic data were obtained from the U. S. Departments of Labor and Agriculture and were checked by State health agencies.

Urban Fringe Sanitation

A selected bibliography

PHS Publication No. 583 (Public Health Bibliography Series No. 18). 1958. By Warren F. Smith. 27 pages. 15 cents.

One hundred annotated references have been prepared to assist sanitary engineering personnel. The bibliography is organized under four subjects: water supply, sewerage, refuse, and planning, with further breakdowns as to administrative, economic, and technical articles for the water and sewerage portions.

Rabies: Methods in Laboratory Diagnosis

PHS Publication No. 568. 1957. By Ernest S. Tierkel and Helen O. Neff. 42 pages; illustrated. 25 cents.

Designed to provide a practical guide for workers concerned with routine rabies diagnosis, this manual presents techniques selected for their simplicity, dependability, and economy.

The subjects cover preparation of suspected tissues for laboratory diagnosis, microscopic examination for Negri bodies and performance of the biological diagnostic test. Information on packing and shipping specimens and regulations covering their transportation plus a sample animal history form and a list of selected readings are included.

Control of Domestic Rats and Mice

PHS Publication No. 563. 1957. By Bayard F. Bjornson and Charles V. Wright. 25 pages; illustrated. 25 cents.

This training handbook describes briefly rodent-borne diseases, such as murine typhus, plague, rat-bite fever, salmonellosis, and rickettsialpox, and discusses identification and biology of domestic rats and mice.

The role of sanitation, including proper storage, collection and disposal of refuse, as well as methods of rodent killing, trapping, rodenticides, and burrow gassing, are emphasized. Simple methods of ratproofing, formulas for common rodenticides, and methods of controlling rodent ectoparasites are given.

Patients and Personnel Speak

A method of studying patient care in hospitals

PHS Publication No. 527. 1957. By Faye G. Abdellah and Eugene Levine. 33 pages. 30 cents. (Checklist forms for patients and personnel, $3.00 per 100.)

The technique used successfully by 60 American Hospital Association member hospitals to evaluate their nursing services has been refined and made available in this manual.

The booklet discusses the value of studying patient care, how to get started, the responsibilities of study personnel, and how to tabulate and analyze the data.

Forms for gathering data and a tested checklist on which hospital patients, doctors, administrators, and nursing staffs can state their personal observations of gaps in service are included.

Information Leaflets

GOOD TEETH. *PHS Publication No. 405. (Health Information Series No. 83) Revised 1957. 11 pages. 10 cents.* Gives pointers on dental care for children from infancy through childhood. Discusses the value of fluoridation and tells at what ages topical applications of fluoride should be made.

SIMPLE GOITER. *PHS Publication No. 100. (Health Information Series No. 56.) Revised 1957. Leaflet. $2.00 per 100.* Describes briefly cause, effect, prevention, and treatment of simple goiter.

GALLSTONES AND GALL BLADDER DISEASE. *PHS Publication No. 99. (Health Information Series No. 58.) Revised 1957. Leaflet. $3.00 per 100.* Describes gallstones, the symptoms they produce, and emergency treatment. Discusses importance of consulting a physician.

This section carries announcements of new publications prepared by the Public Health Service and of selected publications prepared by other Federal agencies.

Unless otherwise indicated, publications for which prices are quoted are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Orders should be accompanied by cash, check, or money order and should fully identify the publication. Public Health Service publications which do not carry price quotations, as well as single sample copies of those for which prices are shown, can be obtained without charge from the Public Inquiries Branch, Office of Information, Public Health Service, Washington 25, D. C.

The Public Health Service does not supply publications other than its own.

U. S. GOVERNMENT PRINTING OFFICE: 1958